NAVSHIPS 91678

INSTRUCTION BOOK

for

RADIO RECEIVING SET AN/URR-23A

COLLINS RADIO COMPANY
Cedar Rapids, Iowa

BUREAU OF SHIPS NAVY DEPARTMENT

Contract: NObsr–52527 *Approved by BuShips: 6 June 1952*

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LIST OF EFFECTIVE PAGES

PAGE NUMBERS	CHANGE IN EFFECT	PAGE NUMBERS	CHANGE IN EFFECT
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1-0 to 1-5	Original	7-1 to 7-49	Original
2-0 to 2-148	Original	8-0 to 8-173	Original
3-1 to 3-4	Original	i-0 to i-5	Original

DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code-993-100
6 June 1952

From: Chief, Bureau of Ships
To: All Activities Concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Radio Receiving Set AN/URR-23A NAVSHIPS 91678

1. This is the instruction book for the subject equipment and is in effect upon receipt.

2. When superseded by a later edition, this publication shall be destroyed.

3. Extracts from this publication may be made to facilitate the preparation of other Department of Defense Publications.

4. All Navy requests for NAVSHIPS Electronics publications should be directed to the nearest District Publications and Printing Office. When changes or revised books are distributed, notice will be included in the Bureau of Ships Journal and in the Index of Bureau of Ships General and Electronics Publications, NAVSHIPS 250-020.

H. N. WALLIN
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTEE

RADIO ONE YEAR GUARANTEE: The equipment, including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government, provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing condition, against defects in design with the understanding that if ten per cent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred per cent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any such defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

INSTALLATION RECORD

Contract Number NObsr-52527 Date of Contract, 22 June 1951

Serial Number of equipment _____

Date of acceptance by the Navy _____

Date of delivery to contract destination _____

Date of completion of installation _____

Date placed in service _____

Blank spaces on this page shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised). The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the Bureau of Ships Manual or superseding instructions.

ORDERING PARTS

All request or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

DESTRUCTION OF ABANDONED MATERIAL IN THE COMBAT ZONE

In case it should become necessary to prevent the capture of this equipment, and when ordered to do so, DESTROY IT SO THAT NO PART OF IT CAN BE SALVAGED, RECOGNIZED, OR USED BY THE ENEMY. BURN ALL PAPERS AND BOOKS.

Means:

1. Explosives, when provided.
2. Hammers, axes, sledges, machetes, or whatever heavy object is readily available.
3. Burning by means of incendiaries such as gasoline, oil, paper or wood.
4. Grenades and shots from available firearms.
5. Burying all debris, where possible and when time permits.
6. Throwing overboard or disposing of in streams or other bodies of water.

Procedure:

1. Obliterate all identifying marks. Destroy nameplates and circuit labels.
2. Demolish all panels, castings, switch and instrument boards.
3. Destroy all controls, switches, relays, connections and meters.
4. Rip out all wiring and cut interconnections of electrical equipment. Smash gas, oil, and water cooling systems in gas engine generators, etc.
5. Smash every electrical or mechanical part, whether rotating, moving or fixed.
6. Break up all operating instruments such as keys, phones, microphones, etc.
7. Destroy all classes of carrying cases, straps, containers, etc.
8. Bury or scatter all debris.

DESTROY EVERYTHING!

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the Bureau of Ships Manual or superseding instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltage which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

While every practicable safety precaution had been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS:

Operating personnel must at all time observe all safety regulations. Do not change tubes or make adjustments inside equipment with high voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors. To avoid casualties always remove power and discharge and ground circuits prior to touching them.

DON'T SERVICE OR ADJUST ALONE:

Under no circumstances should any person reach within or enter the enclosure for the purpose of servicing or adjusting the equipment without the immediate presence or assistance of another person capable of rendering aid.

DON'T TAMPER WITH INTERLOCKS:

Do not depend upon door switches or interlocks for protection but always shut down motor generators or other power equipment. Under no circumstances should any access gate, door, or safety interlock switch be removed, short-circuited, or tampered with in any way, by other than authorized maintenance personnel, nor should reliance be placed upon the interlock switches for removing voltages from the equipment.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

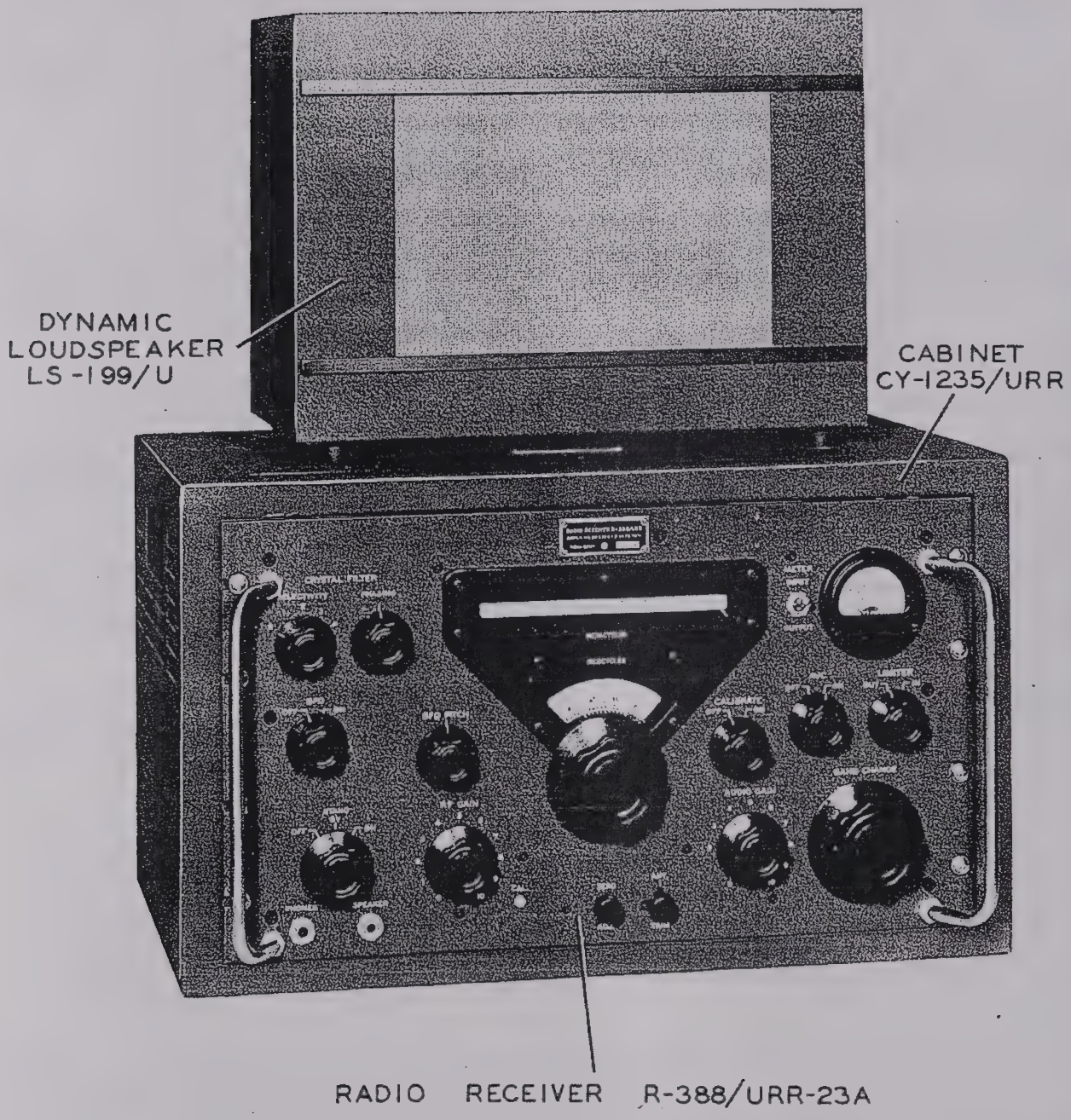


Figure 1-1. Radio Receiving Set AN/URR-23A

SECTION 1
GENERAL DESCRIPTION

1. PURPOSE OF BOOK.

This instruction book has been prepared to assist in the installation, operation, and maintenance of Radio Receiving Set AN/URR-23A.

2. PURPOSE OF EQUIPMENT.

The receiver is designed for communications applications which require the highest order of stability and dial accuracy. Under normal operating conditions, the receiver tunes the range of 540 kc to 30.5 mc with a normal setting error and drift of less than one kc at any frequency within its range. Although designed primarily for amplitude-modulated and continuous-wave reception, the accuracy and stability of the receiver also make it suitable for applications where it is desired to receive or set definite frequencies without search or frequent adjustment.

3. DESCRIPTION OF EQUIPMENT.

The receiver is suitable for 19" rack mounting or for table mounting in the cabinet supplied. Overall receiver dimensions without cabinet are: width, 19 inches; height, 10-1/2 inches; and depth behind panel, 13 inches. (See figure 3-2.) The chassis is protected by a top dust cover held in place by three wing-nuts on the rear of the chassis. (See figure 3-3.) A bottom dust cover is held in place by 15 Phillips-head screws on the bottom of the chassis and 4 screws on the rear of the chassis. The bottom cover is removed by sliding it to the rear after removing the screws that hold it in place.

The cabinet for the receiver has the following dimensions: width, 21-1/8 inches; height, 12-3/8 inches; and depth, 13-1/8 inches. The speaker dimensions are: width, 15 inches; height, 10-9/16 inches; and depth, 8-7/8 inches. The speaker, the cabinet, and the receiver front panel are finished in St. James gray wrinkle.

The following controls are located on the front panel. (See figure 1-1.):

R-F GAIN	CRYSTAL FILTER SELECTIVITY
AUDIO GAIN	CRYSTAL FILTER PHASING
BFO ON-OFF	OFF-ON-STANDBY
CALIBRATE ON-OFF	MEGACYCLE TUNING (BAND SWITCH)
BFO PITCH	KILOCYCLE TUNING
AVC ON-OFF	ZERO ADJUST
LIMITER OUT-IN	METER OUTPUT-INPUT
ANT. TRIM	CAL. (100-KC ADJUSTMENTS)

4. BASIC PRINCIPLE OF OPERATION.

a. MECHANICAL. - The tuning range of 0.5 to 30.5 mc is divided into 30 bands, each one megacycle wide. Bands are selected by the BAND CHANGE knob and indicated by a slide-rule type dial calibrated at .1-megacycle (100-kc) intervals. The KILOCYCLE tuning control covers each of these megacycle intervals with ten turns of a 100-division circular dial calibrated at one kilocycle intervals. Receiver stability is consistent with this finely divided calibration throughout the entire tuning range.

A 4-ohm headphone jack and a 600-ohm speaker jack are provided on the front panel. The antenna connector, 50-ohm i-f output connector, break-in relay terminals and 4-ohm and 600-ohm audio output terminals are provided on the rear. (See figure 3-3.) Also, a heavy duty a-c power cord extends from the rear of the chassis.

b. ELECTRICAL. - Where advantageous, the receiver uses single, double or triple conversion in tuning the entire operating range of 540-kc to 30.5 mc. Eighteen tubes, three of which are dual, are employed in the receiver. With the exception of the rectifier tube, all are of the miniature type.

The receiver tuned circuits cover the frequency spectrum from 500 kc through 30.5 mc. Thus band 1 is referred throughout this book as covering the range, 0.5 to 1.5 mc. However, the lower operating limit is considered to be 540-kc rather than 500-kc. Reception of signals in the range approaching 500-kc is limited because of proximity of the signal frequency to the fixed 500-kc intermediate frequency employed in the receiver.

The tuning range is divided into 30 one-megacycle bands by a system of switches and coils that are parts of the r-f amplifier and first mixer circuits. Bands are changed by moving powdered iron slugs into the coils in one megacycle steps until the coil's inductance limits are reached, then changing coils and repeating. Tuning involves positioning these slugs within the one-megacycle intervals. Injection voltage for the first mixer is obtained from either the fundamental or the harmonic output of an oscillator, the frequency of which is controlled by one of ten quartz crystals selected by the BAND CHANGE control. The KILOCYCLE tuning control drives a vernier dial calibrated in 100 one-kilocycle divisions. This control operates through a differential mechanism to move the slugs in the coils until they cover the range between the one megacycle band change steps. Thus the BAND CHANGE control selects coils and crystals and roughly positions the tuning slugs. It also selects one of two ranges of the variable i-f channel.

Crystal frequencies for first mixer injection are so chosen that the frequency produced by the first mixer always falls in either the 1.5 to 2.5 or the 2.5 to 3.5-mc range of the variable i-f channel.

Exceptions to the operation just described are bands 1, 2, and 3. Band 1 (0.5 to 1.5 mc) uses an intermediate mixer between the first mixer and the variable i-f coils. This mixer accepts frequencies in the range of 10.5 to 11.5 mc from the first mixer. These frequencies are produced by applying to the first mixer a 12-mc signal from the crystal oscillator. This oscillator also applies an 8-mc voltage to the band 1 mixer to produce a signal within the range of the i-f channel that tunes from 2.5 to 3.5 mc. Bands 2 and 3, which cover 1.5 to 2.5 and 2.5 to 3.5 mc respectively, are identical in span to each channel of the variable frequency i-f coils; thus they feed through to the second mixer without utilizing the first mixer.

Following the variable if and the second mixer are the crystal filter and a three-stage fixed intermediate-frequency amplifier. Conversion to the fixed if of 500 kc is accomplished by injecting into the second mixer a 2 to 3-mc variable frequency oscillator signal. This oscillator signal combines with either of the two variable intermediate frequencies, 1.5 to 2.5 and 2.5 to 3.5 mc, to produce the difference frequency of 500 kc. The variable frequency oscillator is tuned by the kilocycle tuning control in step with all other circuits.

Stability of the vfo is assured by temperature-compensated components operating in a sealed and moisture-proof housing.

Separate diodes are used to produce automatic volume control and audio voltages. D-c amplification of the automatic volume control voltage is provided to obtain essentially uniform input to the detector. Audio power output is held within 3.5 db over signal input voltage ranges of five to 125,000 microvolts at the antenna terminals. A series type noise limiter clips modulation at 50-85 percent. This allows good reception in the presence of strong noise pulses.

5. REFERENCE DATA.

CONTRACT NUMBER AND DATE:	NObsr-52527, 22 June 1951
CONTRACTOR AND MANUFACTURER:	Collins Radio Co., Cedar Rapids, Iowa
COGNIZANT NAVAL INSPECTOR:	Assistant Inpsector of Navy Material, Cedar Rapids, Iowa
NUMBER OF PACKAGES INVOLVED, INCLUDING SPARE PARTS:	
TOTAL CUBICAL CONTENTS:	
TOTAL WEIGHT:	

OPERATING RANGE:	540 kc to 30.5 mc
TYPE OF RECEPTION:	AM, CW or MCW
CALIBRATION:	Direct reading in megacycles and kilocycles
TUNING:	Linear tuning with uniform bandspread
FREQUENCY STABILITY:	Dial calibration at room temperature is within 300 cps if the nearest 100-kc calibration point is used to adjust the fiducial.
TEMPERATURE RANGE:	-20°C (-4°F) to +60°C (140°F)
SENSITIVITY:	Band 1 - Less than 15 uv gives 1 watt with 10 db s/n
	Bands 2 to 30 - Less than 5 uv gives 1 watt with 10 db s/n
SELECTIVITY:	Total bandwidth is 5.5 to 6.5 kc at 6 db down and 17 to 20 kc at 60 db down. With crystal filter in, total bandwidth is 0.2 kc at 6 db down and 12 kc at 60 db down.
SPURIOUS FREQUENCY RESPONSE:	Down at least 40 db
AUTOMATIC VOLUME CONTROL:	Less than 3.5 db increase in audio power output with an increase in r-f signal from 5 to 125,000 uv
S METER:	Meter calibrated in 20, 40, 60, 80, and 100 db above avc threshold and -10 to +6-db audio level with 6 mw as reference.
NOISE LIMITER:	Series type ahead of the first audio stage
AUDIO POWER OUTPUT:	1-1/2 watts at 1000 cps with less than 15% distortion
AUDIO FREQUENCY RESPONSE (overall):	Not more than 3 db at 200 cps and not more than 7 db at 2500 cps
AUDIO OUTPUT IMPEDANCE:	4 and 600 ohms
I-F OUTPUT IMPEDANCE:	50 ohms
R-F INPUT IMPEDANCE:	Designed to operate into a high impedance whip or single-ended antenna
POWER REQUIREMENTS:	85 watts at 115 volts 45-70 cps. Same power required when reconnected for 230-volt, 45-70 cps operation

TABLE 1-1 EQUIPMENT SUPPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	OVERALL DIMENSIONS			VOLUME	WEIGHT
			HEIGHT	WIDTH	DEPTH		
1	Radio Receiver	R-388/URR	10-1/2	19	13	1.5	35
1	Cabinet (for above)	CY-1235/URR	12-3/8	21-1/8	13-1/8	2.0	20
1	Speaker	LS-199/U	10-9/16	15	8-7/8	0.82	12.5
2	Instruction Manual	NAVSHIPS 91678	11	8-1/2	1/2	0.027	

TABLE 1-2 EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED

QUANTITY PER EQUIPMENT	NAME OF UNIT	NAVY TYPE DESIGNATION	REQUIRED USE	REQUIRED CHARACTERISTICS
1	Antenna		Receiving Antenna	Single ended or High impedance whip
1	115 volt line		Operation of R-388/URR	Single phase 45-70 cps 85 watt minimum

TABLE 1-3 SHIPPING DATA

SHIPPING BOX NO.	CONTENTS		OVER-ALL DIMENSIONS			VOLUME	WEIGHT
	NAME	DESIGNATION	HEIGHT	WIDTH	DEPTH		
			25	35	31	15.7	208

TABLE 1-4 ELECTRON TUBE COMPLEMENT

SYMBOL DESIGNATION	TUBE TYPE	FUNCTION
V101	6AK5	Radio-frequency amplifier
V102	6BE6	First mixer
V103	6BE6	Band 1 mixer
V104	6BA6	Calibration oscillator
V105	6AK5	High-frequency crystal oscillator
V106	6BE6	Second mixer
V107	6BA6	First 500 kc i-f amplifier
V108	6BA6	Second 500 kc i-f amplifier
V109	6BA6	Third 500 kc i-f amplifier
V110	12AX7	Detector and A. V. C. rectifier
V111	12AU7	A. V. C. amplifier and i-f output cathode follower
V112	12AX7	Noise limiter and first audio amplifier
V113	6AQ5	Audio power amplifier
V114	6BA6	Beat frequency oscillator
V115	5V4	Power rectifier
V116	OA2	Voltage regulator
V001	6BA6	Variable frequency oscillator
V002	6BA6	Oscillator isolation amplifier

SECTION 2
THEORY OF OPERATION

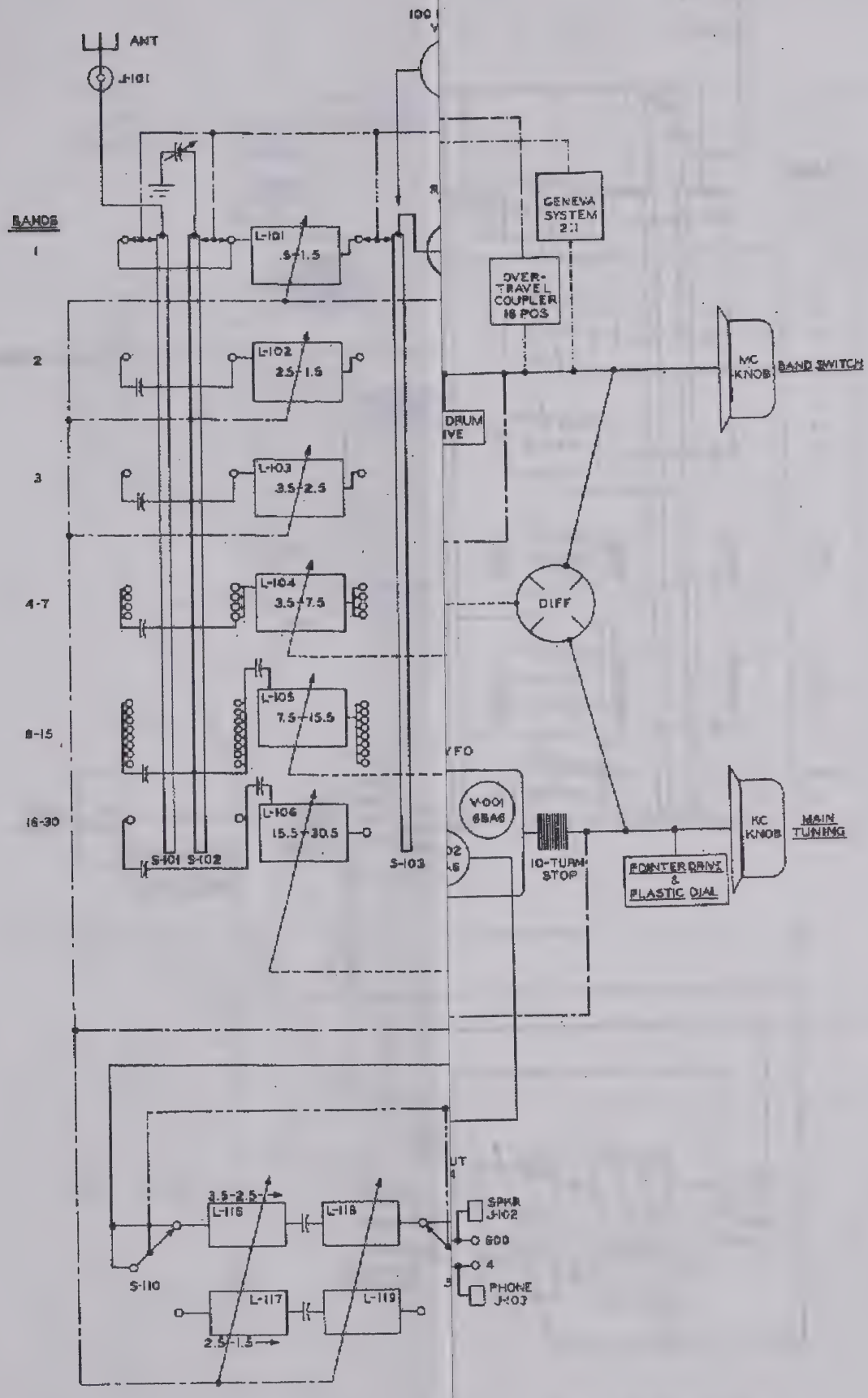
1. MECHANICAL DESCRIPTION.

a. BAND CHANGE. - The receiver covers the frequency range of 0.5 to 30.5 mc in 30 bands: 0.5 to 1.5, 1.5 to 2.5, and so on up to 30.5 mc. Each band is one megacycle wide. Circuits affected by band changes are the r-f amplifier grid, first, second, and third mixer grids, crystal selector, and crystal harmonic tuning circuits. The third mixer is switched in only on band 1 (0.5 to 1.5 mc). See figure 2-1.

Operations involved in the changing of bands consist of selecting the proper coils in these circuits by means of tap switches and changing the position of the tables holding the tuning slugs for the r-f amplifier and first mixer slug tables. All stages are permeability tuned by powdered iron slugs. (See figure 2-2). The r-f amplifier and first mixer slug tables change position a full megacycle in tuning each time a band is changed. This is true of all three slug tables, which tune L104 through L113. However, the tap switches select the proper set of coils for the frequency desired.

Slug tables are driven from two sources: the main tuning knob and the BAND CHANGE knob. These two driving sources are connected to the slug tables through a differential gear mechanism. This is necessary since the coils for bands 4 to 7, 8 to 15, and 16 to 30 cover these tuning ranges with one complete excursion of the tuning slugs. For instance, the band 4 to 7 slug table tunes its associated coils through four megacycles; in one megacycle jumps when operated by the BAND CHANGE knob, and in complete coverage in between when operated by the tuning knob. An interesting feature of the differential gearing is its ability to combine the movements of the two driving sources so that the slug table is moved exactly one megacycle in each band change. The other slug tables operate similarly to the 4 to 7 table, except that the band 8 to 15 table tunes its associated coils through 8 mc, and the band 16 to 30 table tunes its associated coils through 15 mc. These three slug tables are moved simultaneously by means of separate cams.

Switch sections of the band switch are ganged with the BAND CHANGE knob through an over-travel coupler. This over-travel coupler drops the band switch at band 16 while the r-f slug tables continue to operate one position for each band as usual. Refer to figure 2-2. This mechanical diagram shows the gears and connecting shafts associated with band change and tuning. Shafts associated with changing bands are C, D, G, H, I, K, and the overtravel shaft. On band 1, radio frequency coils L101 and L110 are switched by means of the BAND CHANGE knob through the overtravel shaft and shaft G. On bands 2 and 3, the r-f coils are selected by the BAND CHANGE knob through the overtravel shaft and shafts G and K, the coils in the variable i-f section, L116 through L119, being used as additional r-f coils on these bands. On bands 4 to 7, the coils are selected by the BAND CHANGE knob through the overtravel shaft and shaft G, and the position of the slug table is changed through shafts C and D. On these bands the same coils are used for each band. Band change is accomplished by moving the tuning slug in the coil an amount equal to one megacycle in frequency. The slug moves in the coil 0.250 inches for a one megacycle change. On bands 8 to 15, the r-f coils are changed by the overtravel shaft and shaft G, and the position of the slug table is changed one megacycle per band through shafts C and D. The movement of the slug table for a one megacycle change is 0.125 inches. On bands 16 to 30, the r-f coils are switched through the overtravel shaft and shaft G to position 16 where the band switch remains for bands 16 to 30 while the overtravel coupler allows shaft G to rotate through to the thirtieth band. The slugs in the r-f coils are driven through shafts C and D. The slugs travel 0.625 inches during band change. During operation on any band between 4 and 30 the variable i-f channel is alternated from one variable if to the other by shafts G and K. Crystals are selected by



nd Tuning System, Block Diagram

SECTION 2
THEORY OF OPERATION

1. MECHANICAL DESCRIPTION.

a. BAND CHANGE. - The receiver covers the frequency range of 0.5 to 30.5 mc in 30 bands: 0.5 to 1.5, 1.5 to 2.5, and so on up to 30.5 mc. Each band is one megacycle wide. Circuits affected by band changes are the r-f amplifier grid, first, second, and third mixer grids, crystal selector, and crystal harmonic tuning circuits. The third mixer is switched in only on band 1 (0.5 to 1.5 mc). See figure 2-1.

Operations involved in the changing of bands consist of selecting the proper coils in these circuits by means of tap switches and changing the position of the tables holding the tuning slugs for the r-f amplifier and first mixer slug tables. All stages are permeability tuned by powdered iron slugs. (See figure 2-2). The r-f amplifier and first mixer slug tables change position a full megacycle in tuning each time a band is changed. This is true of all three slug tables, which tune L104 through L113. However, the tap switches select the proper set of coils for the frequency desired.

Slug tables are driven from two sources: the main tuning knob and the BAND CHANGE knob. These two driving sources are connected to the slug tables through a differential gear mechanism. This is necessary since the coils for bands 4 to 7, 8 to 15, and 16 to 30 cover these tuning ranges with one complete excursion of the tuning slugs. For instance, the band 4 to 7 slug table tunes its associated coils through four megacycles; in one megacycle jumps when operated by the BAND CHANGE knob, and in complete coverage in between when operated by the tuning knob. An interesting feature of the differential gearing is its ability to combine the movements of the two driving sources so that the slug table is moved exactly one megacycle in each band change. The other slug tables operate similarly to the 4 to 7 table, except that the band 8 to 15 table tunes its associated coils through 8 mc, and the band 16 to 30 table tunes its associated coils through 15 mc. These three slug tables are moved simultaneously by means of separate cams.

Switch sections of the band switch are ganged with the BAND CHANGE knob through an over-travel coupler. This over-travel coupler drops the band switch at band 16 while the r-f slug tables continue to operate one position for each band as usual. Refer to figure 2-2. This mechanical diagram shows the gears and connecting shafts associated with band change and tuning. Shafts associated with changing bands are C, D, G, H, I, K, and the overtravel shaft. On band 1, radio frequency coils L101 and L110 are switched by means of the BAND CHANGE knob through the overtravel shaft and shaft G. On bands 2 and 3, the r-f coils are selected by the BAND CHANGE knob through the overtravel shaft and shafts G and K, the coils in the variable i-f section, L116 through L119, being used as additional r-f coils on these bands. On bands 4 to 7, the coils are selected by the BAND CHANGE knob through the overtravel shaft and shaft G, and the position of the slug table is changed through shafts C and D. On these bands the same coils are used for each band. Band change is accomplished by moving the tuning slug in the coil an amount equal to one megacycle in frequency. The slug moves in the coil 0.250 inches for a one megacycle change. On bands 8 to 15, the r-f coils are changed by the overtravel shaft and shaft G, and the position of the slug table is changed one megacycle per band through shafts C and D. The movement of the slug table for a one megacycle change is 0.125 inches. On bands 16 to 30, the r-f coils are switched through the overtravel shaft and shaft G to position 16 where the band switch remains for bands 16 to 30 while the overtravel coupler allows shaft G to rotate through to the thirtieth band. The slugs in the r-f coils are driven through shafts C and D. The slugs travel 0.625 inches during band change. During operation on any band between 4 and 30 the variable i-f channel is alternated from one variable if to the other by shafts G and K. Crystals are selected by

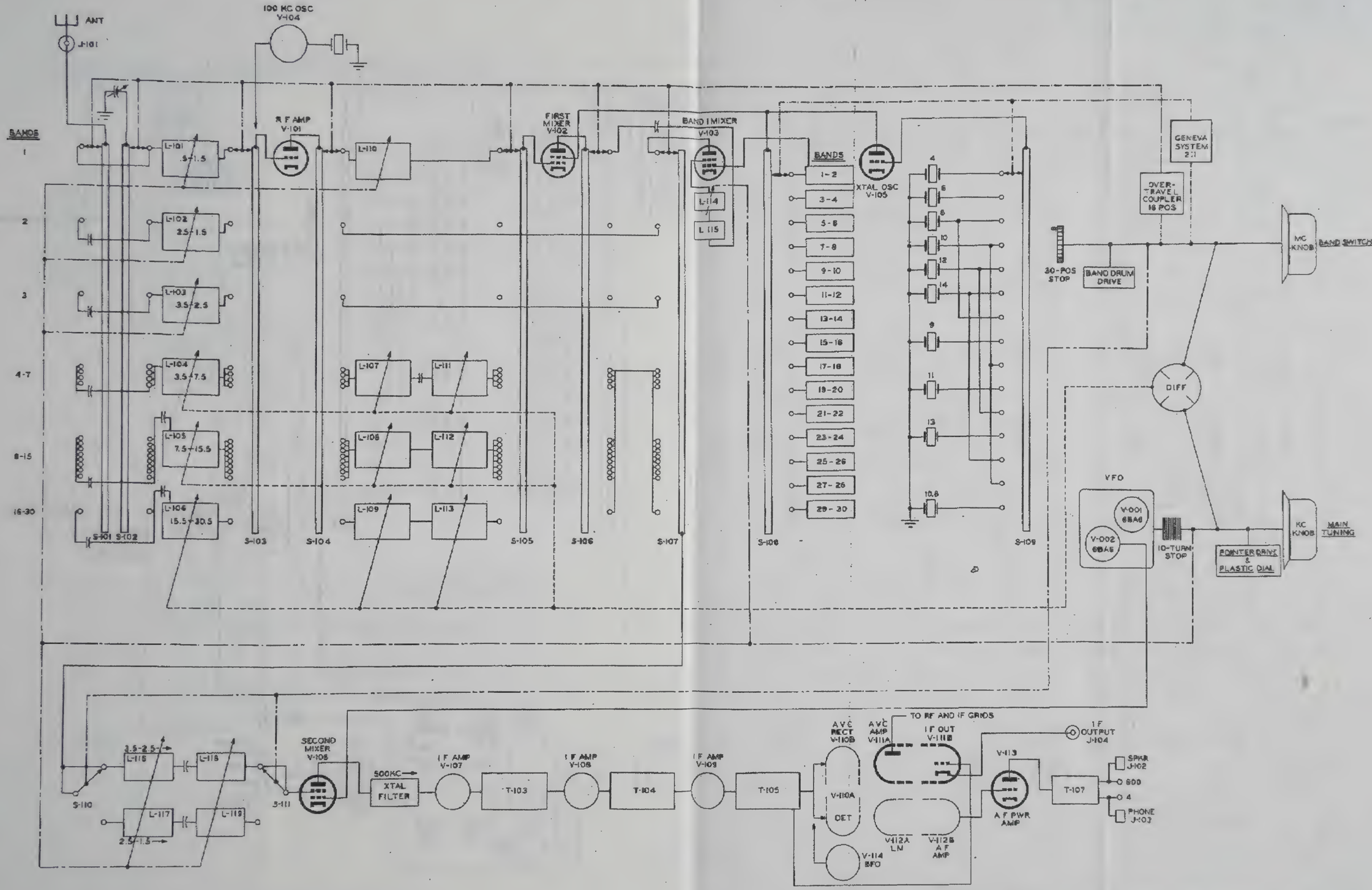


Figure 2-1. Band Change and Tuning System, Block Diagram

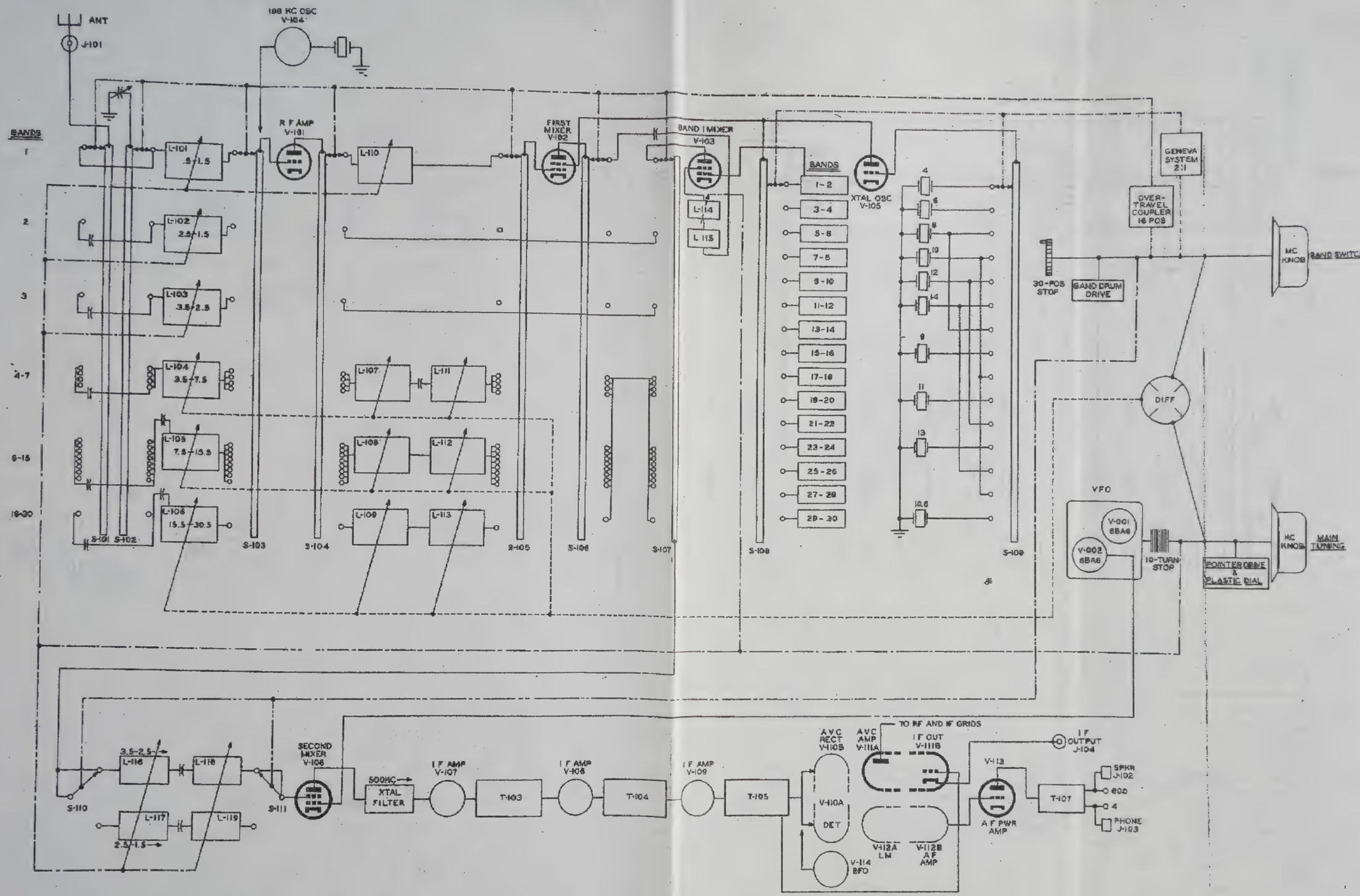
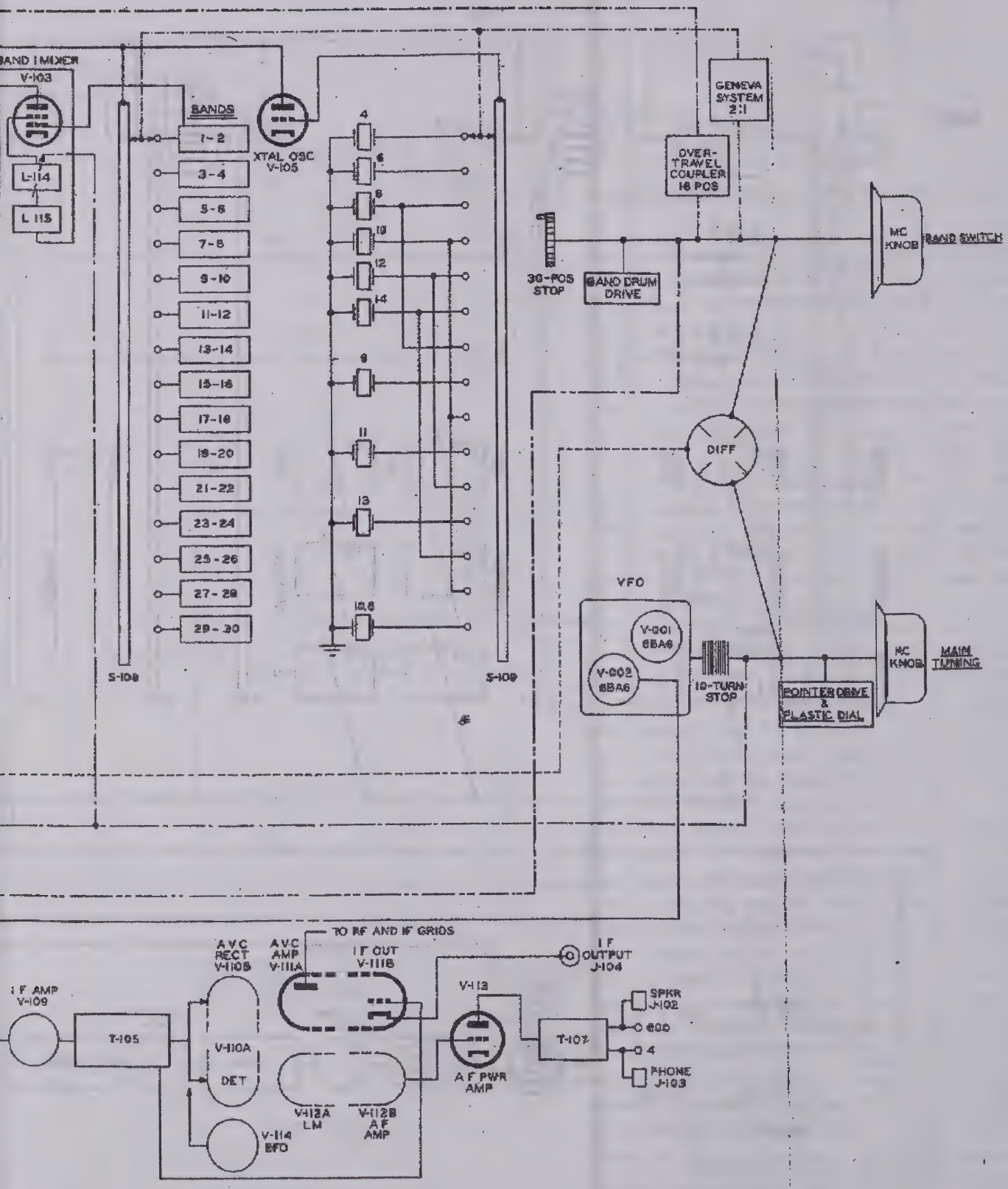
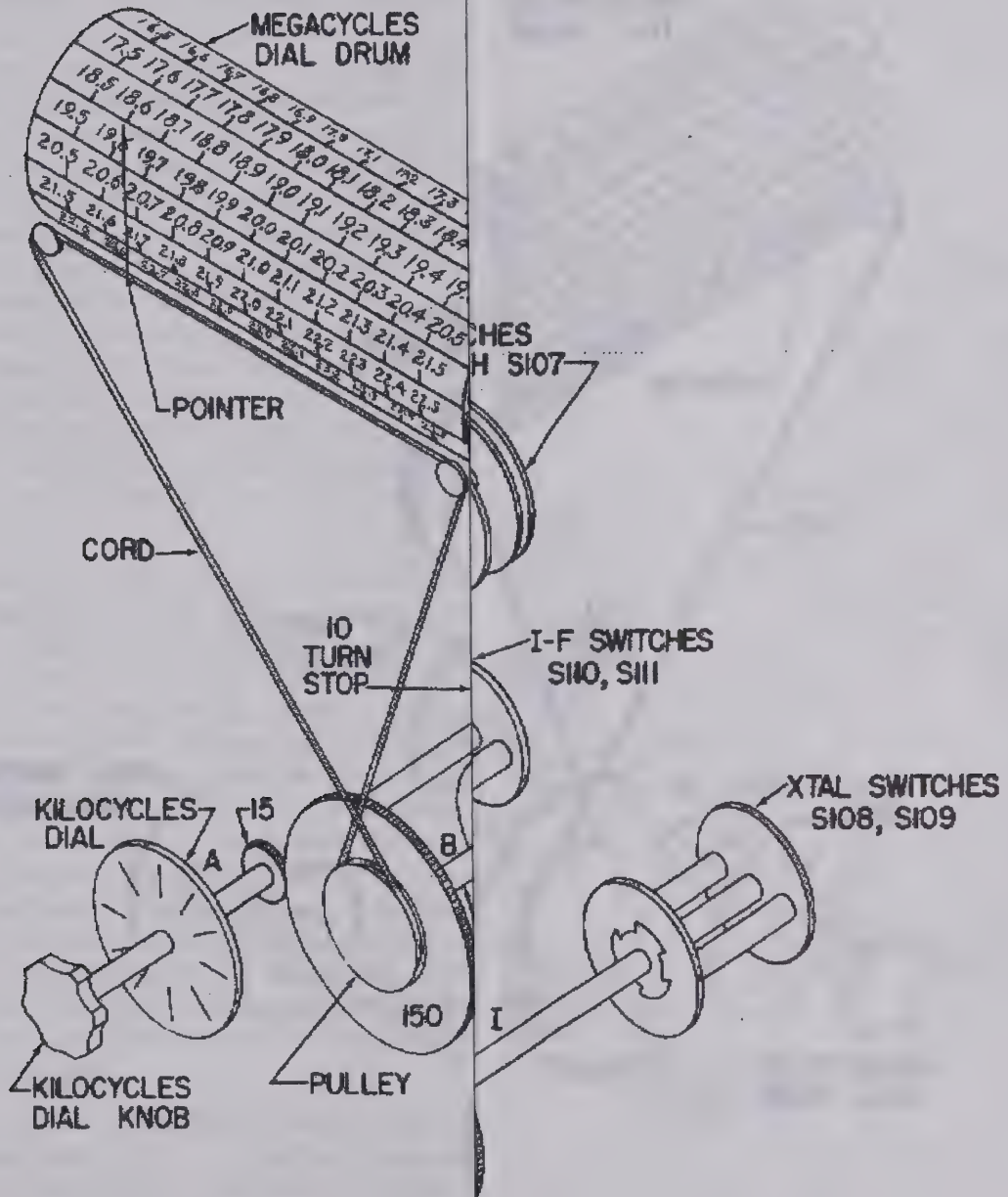


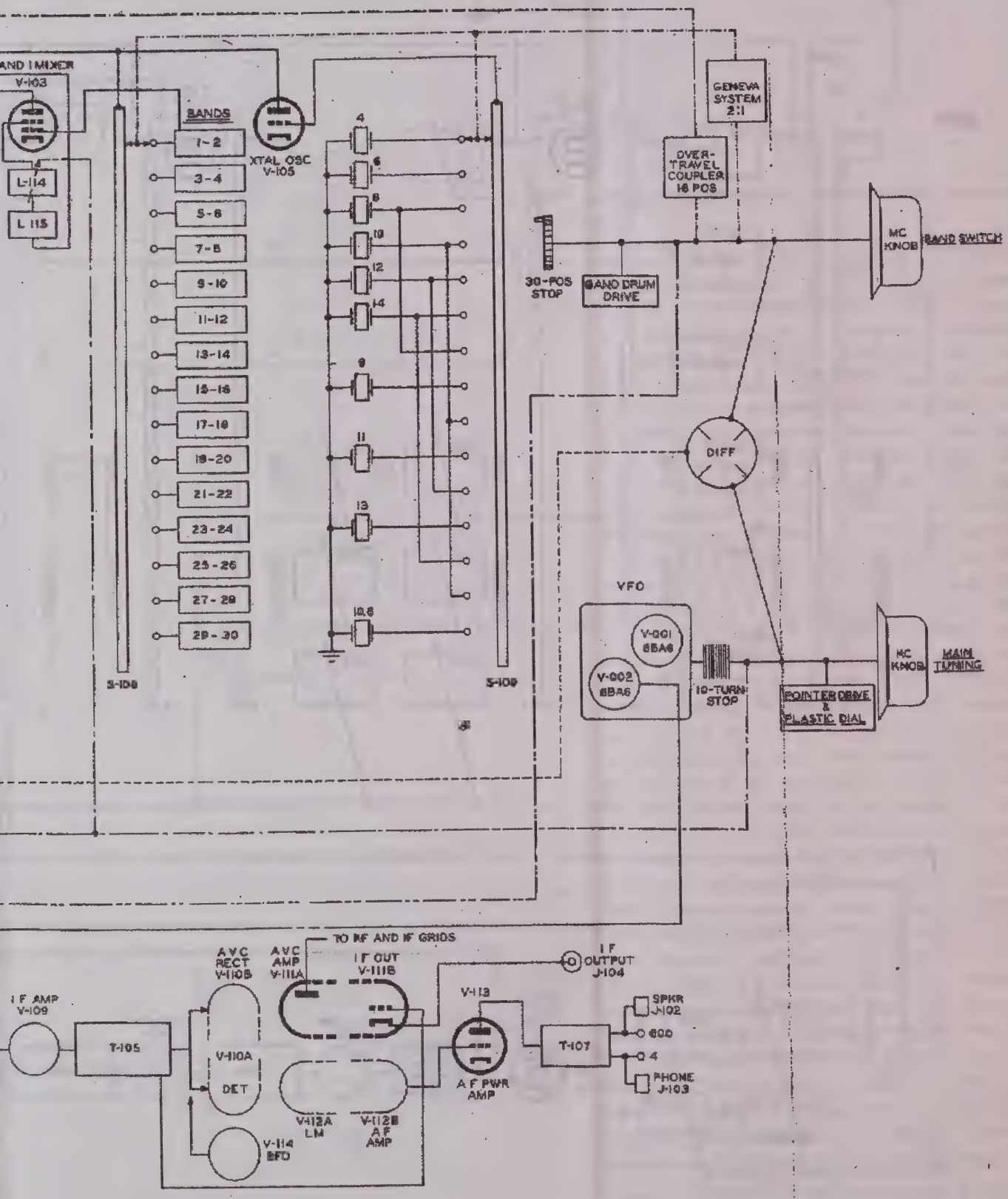
Figure 2-1. Band Change and Tuning System, Block Diagram


BAND I MIXER
V-103
L-114
L 115
BANDS
1-2
3-4
5-6
7-8
9-10
11-12
13-14
15-16
17-18
19-20
21-22
23-24
25-26
27-28
29-30
XTAL OSC
V-105
S-108
S-109
4
6
8
10
12
14
9
11
13
15,6
GENEVA SYSTEM 2:1
OVER-TRAVEL COUPLER 16 POS
36-POS STOP
BAND DRUM DRIVE
MC KNOB
BAND SWITCH
DIFF
VFO
V-901 6BA6
V-902 6BA6
10-TURN STOP
POINTER DRIVE & PLASTIC DIAL
MC KNOB
MAIN TUNING
TO RF AND IF GRIDS
AVC RECT V-110B
AVC AMP V-111A
IF OUT V-111B
IF OUTPUT J-104
V-113
SPKR J-102
600
4
PHONE J-103
IF AMP V-109
T-105
V-110A
DET
V-114 BFO
V-112A LM
V-112B AF AMP
AF PWR AMP
T-107

NOTE:
NUMBERS SHOWN ON GEARS NUMBER OF TEETH.



ical Functional Diagram


AND I MIXER
V-103
L-114
L 115
BANDS
1-2
3-4
5-6
7-8
9-10
11-12
13-14
15-16
17-18
19-20
21-22
23-24
25-26
27-28
29-30
XTAL OSC
V-105
4
6
8
10
12
14
9
11
13
10.6
S-108
S-109
GENEVA SYSTEM 2:1
OVER-TRAVEL COUPLER 16 POS
30-POS STOP
BAND DRUM DRIVE
MC KNOB
BAND SWITCH
DIFF
VFO
V-901 6BA6
V-902 6BA6
10-TURN STOP
POINTER DRIVE & PLASTIC DIAL
MC KNOB
MAIN TUNING
TO RF AND IF GRIDS
AVC RECT V-110B
AVC AMP V-111A
IF OUT V-111B
IF OUTPUT J-104
V-113
SPKR J-102
600
4
PHONE J-103
IF AMP V-109
T-105
V-110A DET
V-112A LM
V-112B AF AMP
V-114 BFO
AF PWR AMP
T-107

NOTE:
NUMBERS SHOWN ON GEARS INDICATE NUMBER OF TEETH.

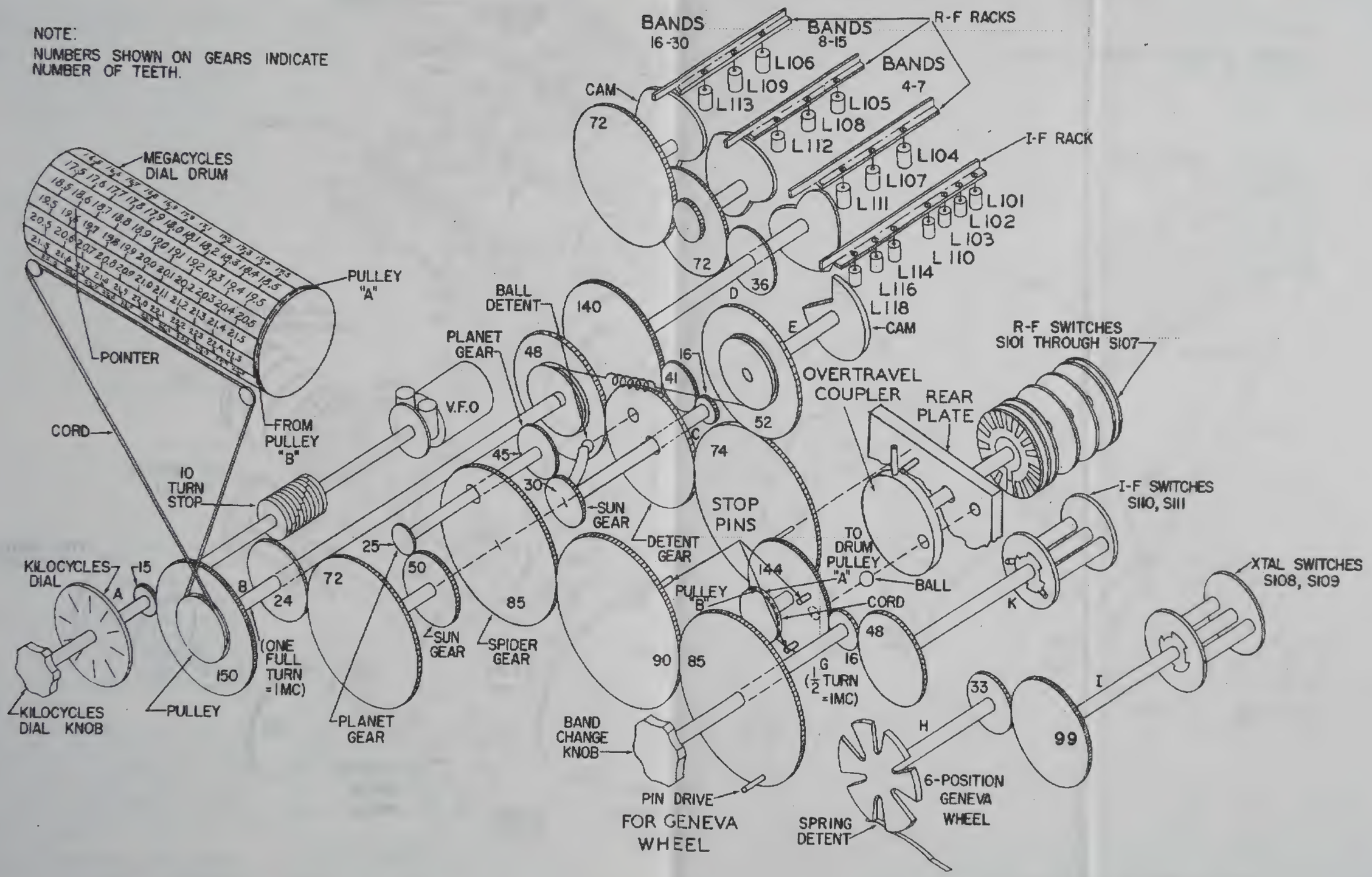


Figure 2-2. Mechanical Functional Diagram

NOTE:
NUMBERS SHOWN ON GEARS INDICATE NUMBER OF TEETH.

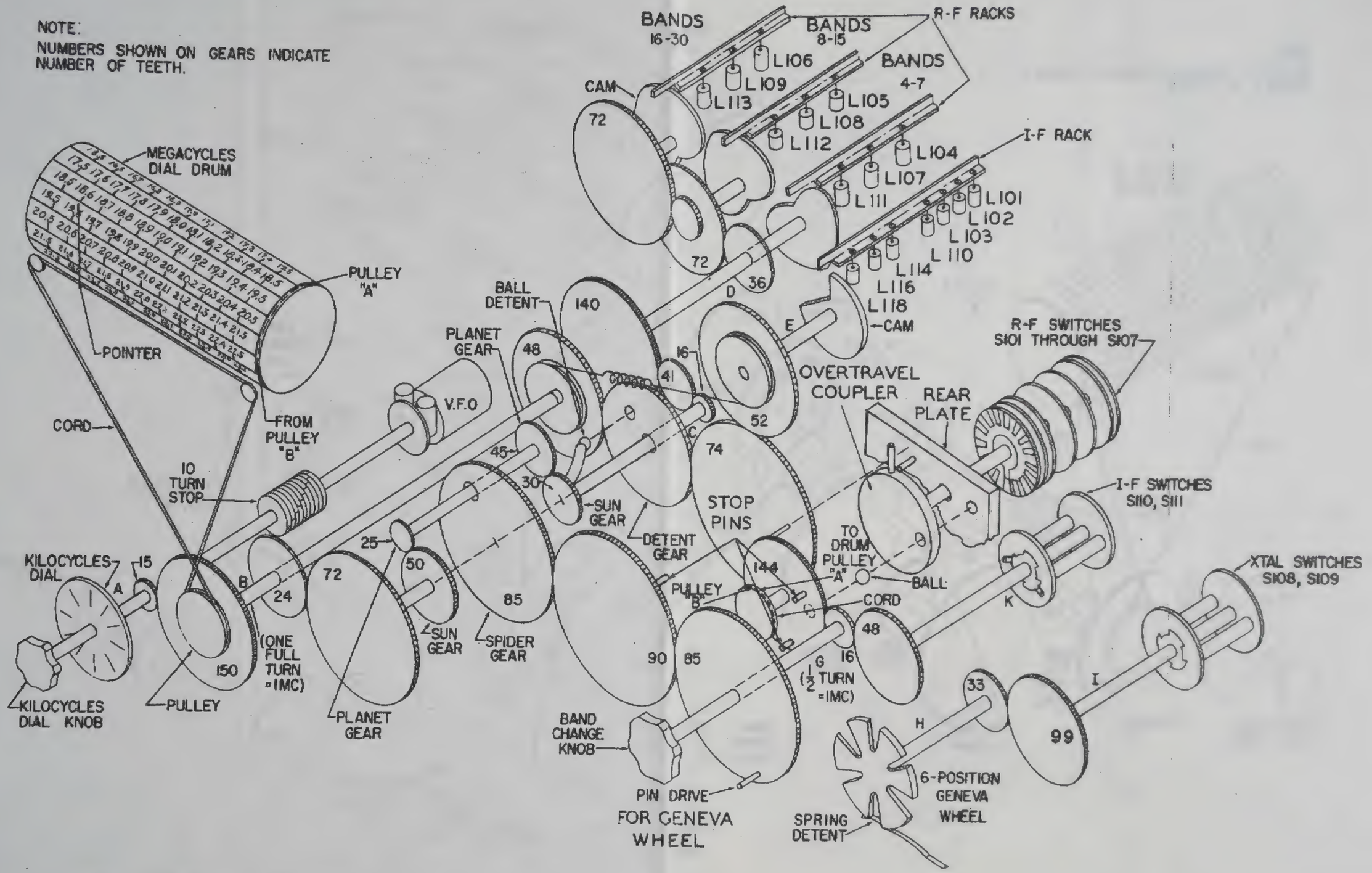
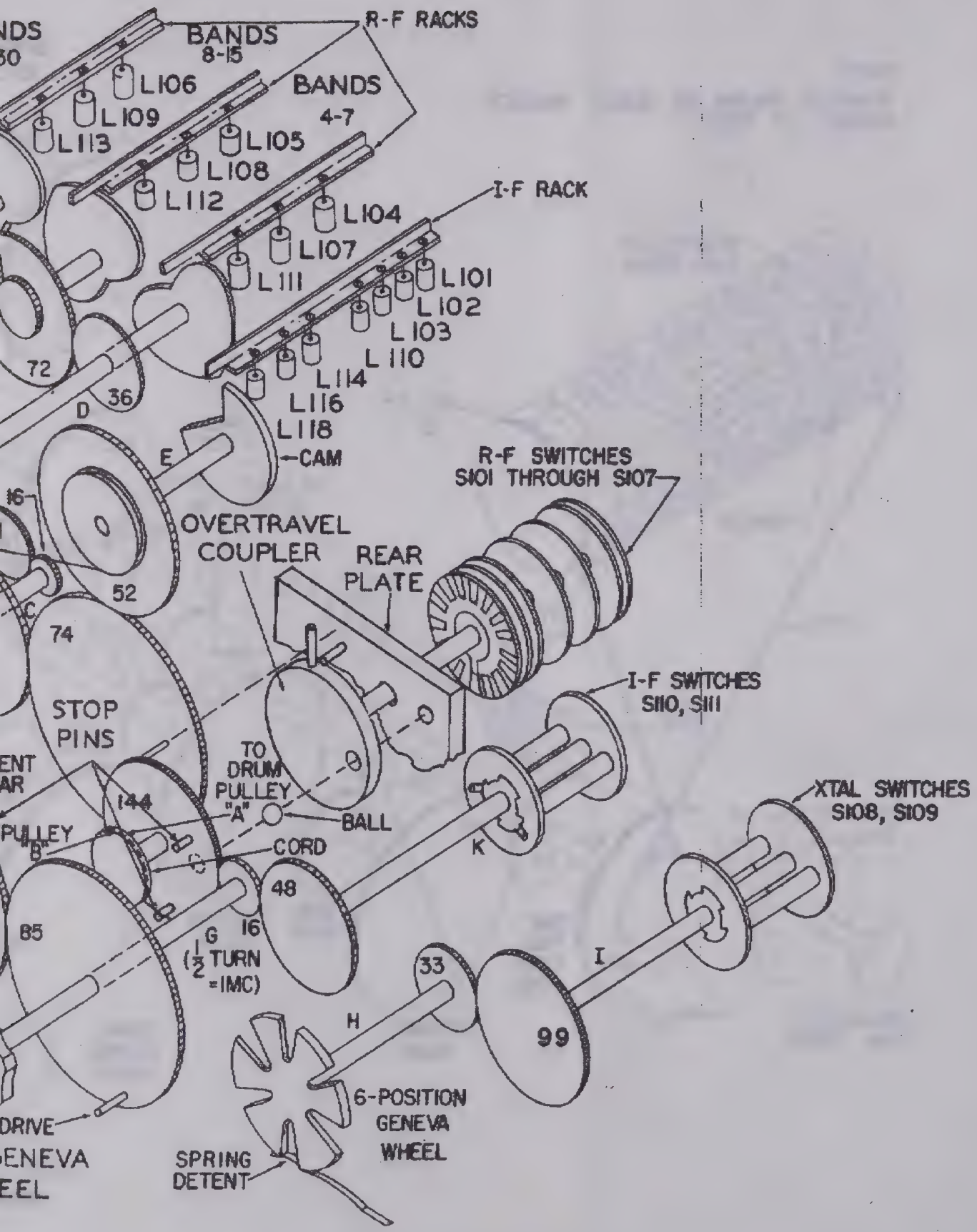


Figure 2-2. Mechanical Functional Diagram


R-F RACKS
BANDS 8-15
BANDS 4-7
I-F RACK
L106
L109
L113
L105
L108
L112
L104
L107
L111
L101
L102
L103
L110
L114
L116
L118
CAM
R-F SWITCHES S101 THROUGH S107
OVERTRAVEL COUPLER
REAR PLATE
I-F SWITCHES S110, S111
XTAL SWITCHES S108, S109
STOP PINS
TO DRUM PULLEY "A"
BALL
CORD
PULLEY "B"
6-POSITION GENEVA WHEEL
SPRING DETENT
DRIVE
GENEVA WHEEL
72
36
D
E
16
52
74
144
48
16
85
G
(½ TURN =1MC)
33
99
H
I
K

operation of the BAND CHANGE knob through the 15-position Geneva system and shafts G, H, and I.

b. TUNING. - The r-f, mixer and variable i-f coils, as well as the variable frequency oscillator coil, are permeability-tuned by powdered iron cores. While tuning, these slugs move in and out of the coils at a rate determined by a cam or by a lead screw. Four slug racks or tables are used in the receiver to perform the function of tuning the r-f, mixer and variable i-f stages. The group of three slug tables in the rear position of the chassis tunes the r-f and first mixer stages when the receiver is operating in the 3.5 to 30.5 mc frequency range (bands 4 to 30). The fourth slug table, located at the right hand edge of the receiver, tunes the r-f stage, the first mixer grid, the third mixer grid, and the variable i-f coils when receiving in the range 0.5 to 1.5 mc. It tunes the r-f stage and variable i-f coils L116 and L118 when receiving in the range 1.5 to 2.5 and 2.5 to 3.5 mc. When receiving in the range 3.5 to 30.5 mc, this slug table tunes only the variable i-f coils L116 and L118. During tuning, positions of the slug tables are varied by a system of gears and cams; see figure 2-2.

On band 1 (0.5 to 1.5 mc) coils L101 and L110 are tuned through this frequency range by the main tuning knob through shafts A, B, C, and E. On bands 2 and 3 (2.5 to 1.5 and 3.5 to 2.5 mc), tuning is done by the main tuning knob through the same shafts -- A, B, C, and E. On band 4 to 7, the main tuning knob tunes coils L104, L107, and L111 over one-fourth of their tuning range through shafts A, B, C, and D and the differential shafts. The BAND CHANGE knob moves this same rack through shafts G, C, D, and the differential in four steps. Each step is equal to one-fourth of the coils' tuning range and the shafts are positioned by means of the spring detent. Thus, L104, L107, and L111 are tuned 1-megacycle steps by the BAND CHANGE knob, and between these steps are tuned by the main tuning knob.

On bands 8 to 15, coils L105, L108 and L112 are tuned through shafts A, B, C, D, and the differential. Each of the two variable frequency i-f channels covers a 1-megacycle range and is tuned by means of the main tuning knob through shafts A, B, and E. The proper channel is selected by the BAND CHANGE knob through shafts G and K.

c. FREQUENCY INDICATION. - The one-megacycle band on which the receiver is operating is indicated on the drum dial that is rotated by the BAND CHANGE knob through shaft G. The 1-megacycle divisions are indicated by a pointer on the slide rule dial. This pointer is driven from the main tuning knob through shaft A. The kilocycle tuning control covers each of the one-megacycle bands with ten turns of a 100-division circular dial calibrated at one kilocycle intervals. Two scales are necessary on this dial because bands 2 and 3 run in opposite directions. Mechanical stops are mounted on the control shafts to prevent overtravel.

2. ELECTRICAL DESCRIPTION.

The receiver is a complete coverage superheterodyne receiver capable of AM and CW reception in the frequency range of 0.5 to 30.5 megacycles. The set covers the tuning range in 30 bands, each band one megacycle wide. Various portions of the tuning spectrum use single, dual, and triple conversion. Three stages of intermediate-frequency amplification and a crystal filter produce the desired degree of selectivity. The receiver also features a low impedance avc, noise limiter, two stages of audio amplification, and a 100-kc frequency spotter or calibrator. See figure 2-3.

The receiver employs dual conversion on most bands and single or triple on others in order to obtain full coverage economically with a minimum of image and other spurious responses on all bands. Band 1, 0.5 to 1.5 mc, uses triple conversion, bands 2 and 3, 1.5 to 3.5 mc, use single conversion, and bands 4 to 30, 3.5 to 30.5 mc, use dual conversion. Each band is numbered on the band's center frequency. For example, band 1 covers 0.5 to 1.5 mc, band 2 covers 1.5 to 2.5 mc, and so on.

On band 1, where triple conversion is necessary, and intermediate mixer is employed between the first and second mixers used in the regular dual conversion scheme. See figure 2-4. The 0.5 to 1.5 -mc carrier on band 1 is fed to the first mixer where it is beat against a 12-mc signal from the h-f crystal oscillator to produce an 11.5 to 10.5-mc signal. This signal is beat against an 8-mc signal in the intermediate mixer to produce the variable if of 3.5 to 2.5 mc. The variable if is then combined with the 3 to 2-mc variable frequency oscillator output to produce the fixed 500-kc if.

On bands 2 and 3, the 1.5 to 3.5-mc carrier is fed directly to the second mixer without intermediate conversion steps since these bands cover the same

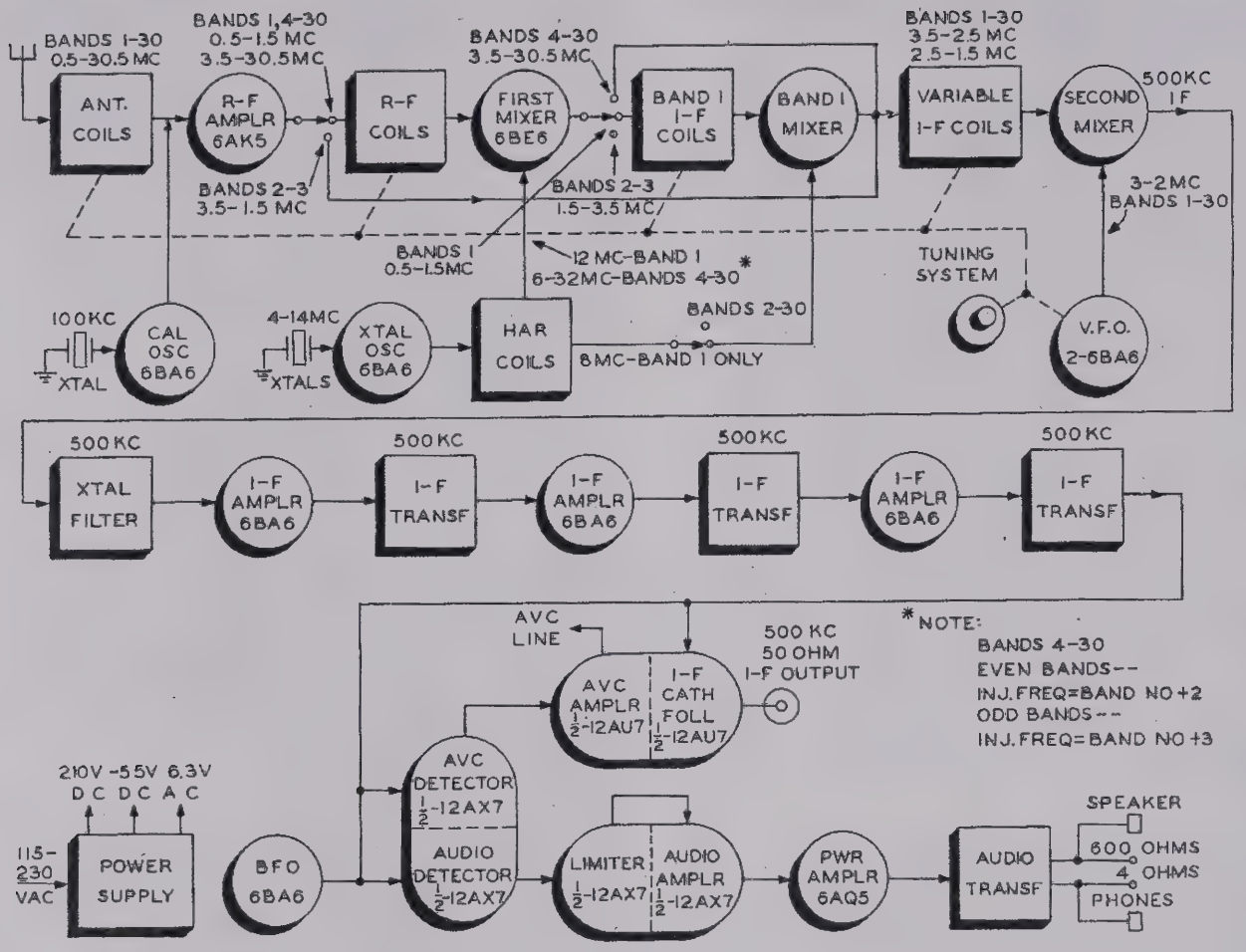


Figure 2-3. Overall Block Diagram

range as the variable if. The signal is then directly beat with the vfo output to produce the fixed 500-kc if. See figure 2-4.

On bands 4 to 30, the regular dual conversion scheme is employed. On the even numbered bands the signal frequency is beat against the high frequency oscillator output to produce a variable if of 2.5 to 1.5 mc. On the odd numbered bands a variable if of 3.5 to 2.5 mc is produced. The variable if is then combined in the second mixer with the vfo output to produce the 500-kc fixed if.

3. CIRCUIT ANALYSIS.

a. RADIO FREQUENCY AMPLIFICATION. - One stage of radio frequency amplification is used on all bands. See block diagram, figure 2-3. The circuit is a conventional r-f amplifier circuit employing a miniature r-f pentode tube 6AK5(V101). This tube type is used because of its low noise and good sensitivity characteristics at high frequencies.

The control grid circuit of this stage is tuned on all bands, the tuned circuits being selected by r-f switch, S103. (See figure 2-1.) The antenna is capacitively coupled to the tuned circuits in the control grid through r-f switches, S101 and S102.

When operating in the American broadcast band (band 1), the plate circuit of the r-f amplifier is impedance-coupled to the grid circuit of the first mixer by resistor R105, and capacitor, C117. (See figure 7-16.) On bands 2 and 3 the plate of the r-f amplifier tube is switched directly to the primary coils of the variable i-f tuner, where additional selectivity is obtained. Single conversion is used on these bands. When operated on bands 4 to 30, the plate circuit is tuned and capacitively coupled to a

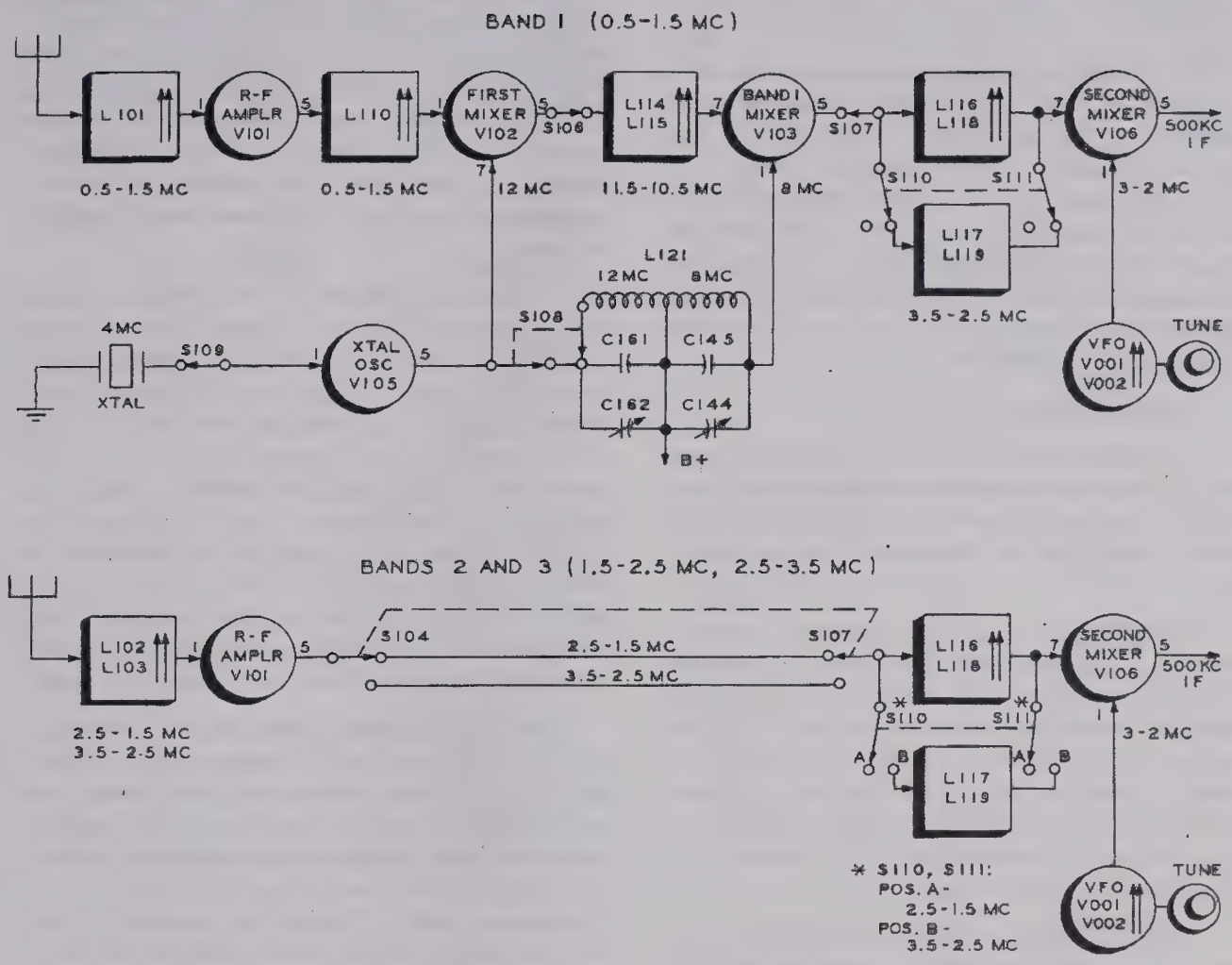


Figure 2-4. Frequency Conversion Circuits

corresponding tuned circuit in the grid of the first mixer stage.

The r-f coils and associated trimmers in the plate circuit are selected by the BAND CHANGE knob and tuned through the various band ranges via the slug table arrangements. The r-f coils for bands 1, 2, and 3 are mounted on the variable i-f slug table which is at the extreme right hand edge of the receiver as viewed from the front. See figure 5-1. The coils for bands 4 to 30 are clustered at the rear of the chassis and are tuned by slugs mounted on the three r-f and mixer slug tables.

b. MIXER STAGES.

(1) FIRST MIXER. - The first mixer stage uses a miniature pentagrid converter tube 6BE6 (V102). This stage is used on all bands except bands 2 and 3, where only one conversion stage is necessary.

The grid 1 circuit (pin 1) receives the r-f signal from the r-f amplifier stage. On band 1, this grid circuit is tuned by L110, C118, and C119, and impedance coupled to the plate of the r-f amplifier through C117 and R105. On bands 4 through 30, the circuit is tuned by the proper coil and trimmer groups selected by the r-f switch S104, and capacitively coupled to corresponding tuned circuits in the plate of the r-f amplifier stage.

The grid 3 (pin 7) input is obtained from the plate of hfo (V105). On bands 4 through 30, the frequency of the heterodyning signal applied to this grid is such as to produce an output frequency which falls in one of the two variable i-f ranges, (2.5 to 1.5 mc or 3.5 to 2.5 mc), depending on which of the bands between 4 and 30 is being operated. On band 1, a 12-mc heterodyning signal is applied to this grid, the output of the stage then being in the range of 11.5 to 10.5 mc, which is again heterodyned in the band 1 mixer stage.

The plate output frequency of this stage is then shown to be in the variable i-f spectrum on bands 4 through 30 and the output applied directly to the tuned variable i-f coils. On band 1, the plate circuit is tuned to the range of 11.5 to 10.5 mc by components L114, L115, C139, and C140, and the output applied for further conversion to the Band 1 Mixer (V103).

(2) SECOND MIXER STAGE. - The second mixer stage also employs a miniature pentagrid converter Tube 6BE6(V106). The circuit is conventional. Input to grid 3 (pin 7) of this stage is always either 3.5 to 2.5 mc or 2.5 to 1.5 mc from the variable i-f coils L116/L118 and L117/L119. The 3.0 to 2.0-mc output of the vfo is fed into the second mixer tube at grid 1 (pin 1) to heterodyne against the input signal and produce the 500-kc intermediate frequency. This mixer stage is used on all bands.

(3) BAND 1 MIXER. - This mixer stage is used only when receiving on band 1, where triple conversion is needed. A miniature pentagrid converter Tube 6BE6 is used in this stage. Grid number 3 (pin 7) of this tube is excited by an 11.5 to 10.5 - mc signal from the plate circuit of the first mixer tube, V102 and grid number 1 (pin 1) is excited by a heterodyning 8-mc signal from the crystal oscillator. The output of the third mixer is then 3.5 to 2.5 mc, which is fed to the grid of the second mixer through the variable i-f coils. This conversion scheme takes place only when receiving on band 1. This stage is not used on any other bands.

c. HIGH FREQUENCY OSCILLATOR. - The high frequency oscillator uses a miniature pentode Tube 6AK5 in a modified Colpitts oscillator circuit. No tuned coils are needed to make the circuit oscillate because in-phase feedback voltage is produced across r-f choke, L120. See figure 7-16. Ten quartz crystals are used to control the frequency of the oscillator output for the various bands. At the minimum, each crystal is switched in for two adjacent bands, i. e. 1-2, 3-4, 5-6, and so on, since the crystal switch S109 changes position only on odd numbered bands. The harmonics of certain crystals are used also for other higher bands. For example, the 8-mc crystal used for bands 5 and 6 is also used for bands 13 and 14 by utilizing its second harmonic at 16 mc. In those instances where harmonic operation is used, (bands 1, and 13 through 30), a tuned circuit picks off the correct harmonic. This tuned circuit is in the plate circuit of the high frequency oscillator, V105, and consists of the section of coil L121 in the hfo plate circuit and a number of tuning capacitors. The latter are selected by switch pie S108.

The circuit consisting of the section of L121 in the grid circuit of the band 1 mixer and capacitors C144 and C145, is tuned to 8 mc and is used when operating on band 1 to furnish the band 1 mixer with an 8-mc

heterodyning signal (second harmonic of the 4-mc crystal). At the same time, the other section of L121 and associated trimmers is tuned to 12 mc (third harmonic of the 4-mc crystal) to furnish the first mixer with the required 12-mc heterodyning signal. A list of the crystals and the bands upon which they function is outlined as follows:

CIRCUIT FREQUENCY

CRYSTAL FREQUENCY	RECEIVER FREQUENCY	BAND	INJECTION FREQUENCY
4	0.5 to 1.5	1	8 and 12
	1.5 to 2.5	2	None
6	2.5 to 3.5	3	None
	3.5 to 4.5	4	6
8	4.5 to 5.5	5	8
	5.5 to 6.5	6	8
	12.5 to 13.5	13	16
	13.5 to 14.5	14	16
10	6.5 to 7.5	7	10
	7.5 to 8.5	8	10
	16.6 to 17.5	17	20
	17.5 to 18.5	18	20
	26.5 to 27.5	27	30
	27.5 to 28.5	28	30
12	8.5 to 9.5	9	12
	9.5 to 10.5	10	12
	20.5 to 21.5	21	24
	21.5 to 22.5	22	24
14	10.5 to 11.5	11	14
	11.5 to 12.5	12	14
	24.5 to 25.5	25	28
	25.5 to 26.5	26	28
9	14.5 to 15.5	15	18
	15.5 to 16.5	16	18
11	18.5 to 19.5	19	22
	19.5 to 20.5	20	22
13	22.5 to 23.5	23	26
	23.5 to 24.5	24	26
10.67	28.5 to 29.5	29	32
	29.5 to 30.5	30	32

The above chart shows how the fundamentals and harmonics of the crystals are used to obtain a 1.5 to 2.5-mc input to the variable i-f coils on even numbered bands and a 2.5 to 3.5-mc input on odd number bands. These signals are then beat against the 2 to 3-mc output of the vfo in the second mixer to obtain the 500-kc i-f signal.

d. VARIABLE INTERMEDIATE FREQUENCY. - The variable intermediate frequency section consists of two channels, one for a frequency of 2.5 to 1.5 mc and the other for 3.5 to 2.5 mc. The 2.5 to 1.5-mc if is used on the even numbered bands which employ double conversion, and the 3.5 to 2.5-mc if is used on the odd numbered bands which employ double conversion. The 2.5 to 1.5-mc if is also used on band 2 as an additional tuned r-f circuit. The 3.5 to 2.5-mc if is used on band 3 as an additional tuned r-f circuit and on band 1, in the usual application, as a variable if.

Using two variable i-f channels in this manner cuts in half the number of crystals needed by the high frequency oscillator, since each crystal's fundamental frequency or useful harmonic is used for two bands. Inductors L116 and L118 form the lower frequency i-f coils (2.5 to 1.5 mc) and are the coils in which the tuning slug travels. The 3.5 to 2.5-mc if is obtained by shunting L117 across L116, and L119 across L118 to lower the inductances of L116 and L118. Switch sections S110 and S111 alternately switch the shunting coils in and out as the BAND CHANGE knob is rotated. The variable i-f coils are situated in the grid circuit of the second mixer stage.

e. VARIABLE FREQUENCY OSCILLATOR. - The receiver circuits described so far have the function of receiving the spectrum in 1-megacycle bands that are presented to the grid of the second mixer. The scheme for obtaining high stability is completed by a method of heterodyning the signals to a lower, fixed intermediate frequency. In this application, a highly stabilized 3 to 2-mc permeability tuned oscillator is employed to heterodyne against the 2.5 to 1.5-mc and the 3.5 to 2.5-mc outputs of the variable frequency if. The resulting 500-kc signal is amplified by the 500-kc i-f amplifier.

The coil in the oscillator is cam wound to produce extremely linear frequency change with linear movement of the tuning slug. The circuit is temperature-compensated and the components are sealed against changes in humidity. Ten turns of the oscillator lead screw produce a linear frequency change of one megacycle. The inductance of the oscillator coil is trimmed by an iron core series inductor, the value of which is adjusted at the factory and sealed. See figure 7-15.

A Tube 6BA6(V002), is used in a buffer stage following the oscillator tube, is for isolation purposes and is an integral part of the oscillator unit.

For stabilization purposes, supply voltages for the oscillator unit are regulated by Tube OA2(V116).

f. CRYSTAL FILTER. - Selectivity of the receiver is improved greatly by use of a crystal filter in the 500-kc i-f channel. The crystal filter circuit consists primarily of 500-kc i-f input transformer T101, a 500-kc crystal, and a high impedance tuned circuit T102, connected as shown in figure 2-5. When SELECTIVITY switch S114 is in position 0, the crystal is shorted and T101 is connected directly to T102. Thus, there is no crystal filter action when S114 is in position 0 and selectivity is determined by the receiver's tuned circuits above. When S114 is in any other position, crystal filter action takes place -- position 4 giving the greatest selectivity.

To analyze the operation of this circuit consider only the loop containing T101 secondary, crystal Y112, and tuned circuit T102. This loop is shown in figure 2-6, considering SELECTIVITY switch to be in position 1. The secondary of T101 is a low impedance coil with a grounded center tap. The primary of T101 is tuned to 500 kc. Consider crystal Y112 in series with T102 as a voltage divider, grid voltage to V107 being taken from the point between Y112 and T102 (point A, figure 2-6). For an i-f signal of exactly 500 kc, impedance of the crystal is very low ---- in the order of 2000 to 4000 ohms. The impedance of T102 is very high----in the order of 100,000 ohms. Thus, for an input to the filter section of exactly 500 kc, nearly all of the voltage output of T101 appears across T102 and is applied to the grid of the first i-f amplifier, V107.

For frequencies a few kilocycles further away from 500 kc, the impedance of the crystal increases greatly. At the frequency where the impedance of the crystal equals that of T102, one half the output of T101 is applied to the grid of the first i-f amplifier. As the frequency deviates farther from the 500-kc value, successively smaller portions of the signal are applied to the first i-f amplifier, V107. This

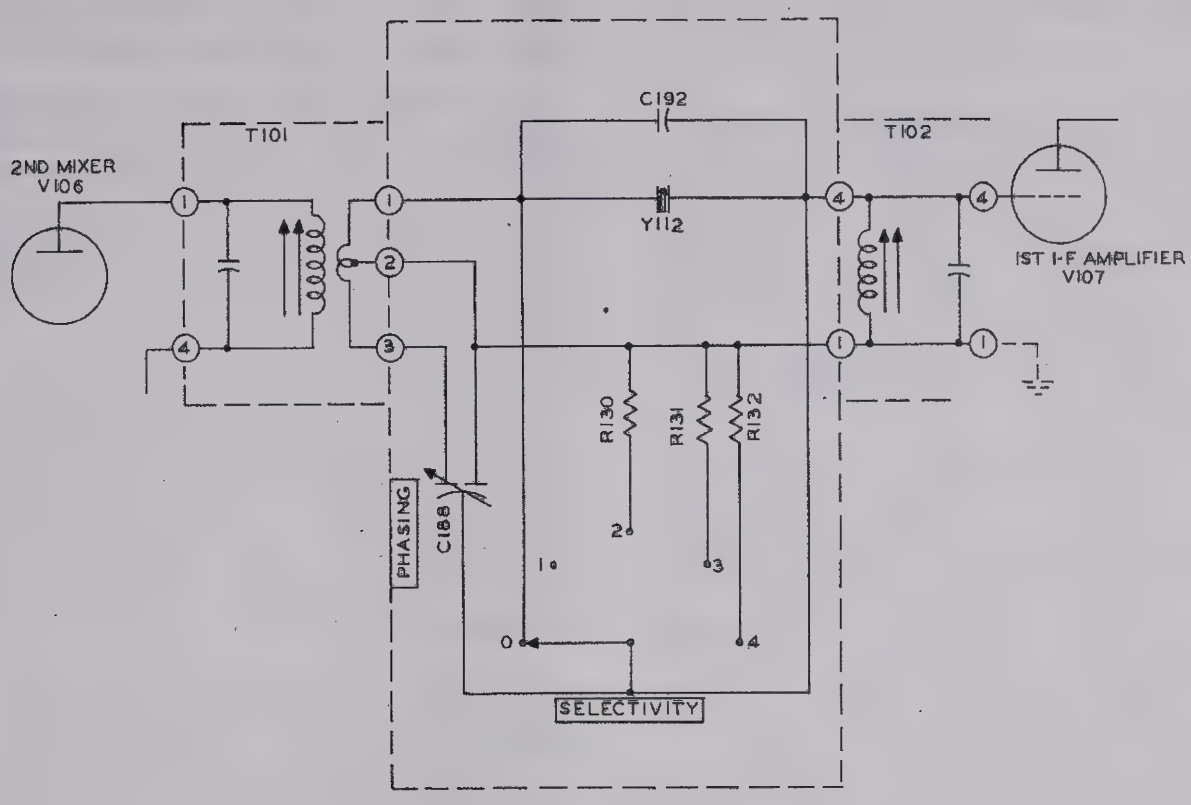


Figure 2-5. Crystal Filter

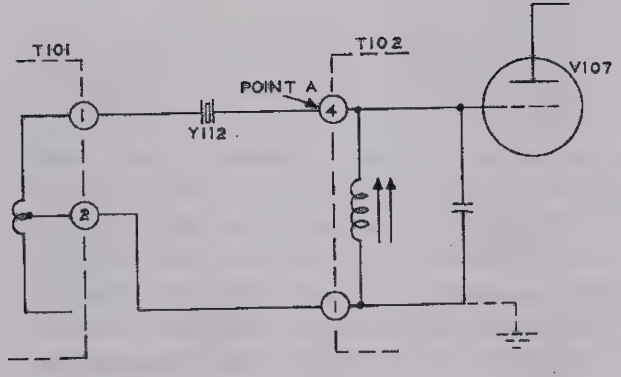


Figure 2-6. Crystal Filter - Simplified, Position 1

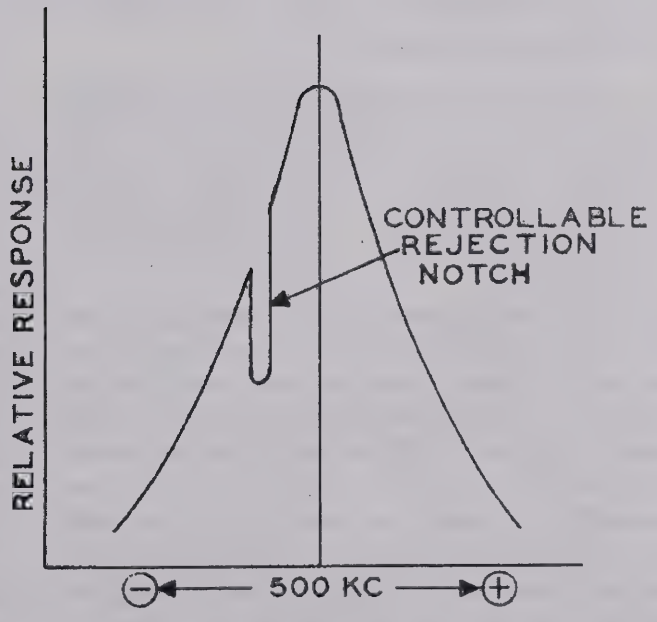


Figure 2-7. Crystal Phasing Rejection Notch

results in a narrower i-f response curve, or in greater selectivity, than that obtained without crystal filtering.

Switching the SELECTIVITY control to positions 2, 3, or 4, merely shunts T102 with successively smaller values of resistance which effectively lower the impedance to T102. Thereby, due to the voltage divider action with the crystal, less output is applied to the grid of the first i-f amplifier. As the effective impedance of T102 decreases, selectivity increases. In the sharpest position the bandwidth is from 200 to 300 cps at 6 db down.

The primary purpose of the crystal phasing capacitor, C188, is to produce a controllable rejection notch in the i-f response curve so that unwanted heterodynes may be tuned out. Referring to figure 2-5, the section of C188 connected to the bottom end of T101 secondary provides a capacitive path around the crystal that balances out the shunt capacitance of the crystal in its holder and external capacitor C187. Varying C188 on either side of the balance point varies the anti-resonant frequency of the crystal circuit within 3 kc on either side of 500 kc. Since the impedance of the crystal circuit at anti-resonance is extremely high, the crystal filter rejects signals at the anti-resonant frequency. Thus at anti-resonant frequency points, the phasing action gives a sharp dip in response and the selectivity curve takes on a notch as illustrated in figure 2-7. This notch can be varied through the response bandwidth by positioning the phasing control.

In order to avoid detuning the tuned circuit T102 when varying C188, a section of C188 is shunted across T102. Since C188 has a split stator and single rotor, the total shunt capacitance across T102 remains practically constant as the setting of C188 is varied.

g. SECOND INTERMEDIATE FREQUENCY AMPLIFIER SECTION. - The second intermediate frequency amplifier section is fixed-tuned to 500 kc. It consists of three stages each employing a Tube 6BA6. Input tube, V107, is excited by the crystal filter output coil, T102. Permeability-tuned transformers, with output taps taken off the secondary coils near the ground end, are used to produce the desired i-f selectivity. All three stages are supplied with avc voltage. Plate and fixed screen voltages in these three stages are controlled by the ON-STANDBY-OFF switch and the remote operation relay, K101, which remove these voltages to render the receiver inoperative during transmission periods.

h. DETECTOR. - The detector in the receiver consists of one half of a dual triode Tube 12AX7(V110), pin numbers 6, 7, and 8. The circuit, as shown in figure 7-16, uses the tube as a diode, the grid being tied to the plate. Rectificiation takes place between the cathode and plate, with resistors R150 and R151 acting as load resistors and C202 supplying the necessary r-f filtering.

i. NOISE LIMITER. - A series type noise limiter is used in the receiver. This limiter employs one-half (pins 1, 2, and 3) of a dual triode Tube 12AX7 (V112). Refer to figure 2-8. Due to the a-c loading of the detector, heavy noise impulses are automatically clipped from the positive audio peaks in the detector. The noise appearing on the negative side of the audio cycle is clipped by the noise limiter.

In operation, a negative voltage produced by rectification of the carrier is developed across capacitor C205C. This voltage cannot change rapidly due to the value of the time constant formed by C205C and R152. This negative potential is placed upon the cathode of the noise limiter tube through R153. The cathode is then negative with respect to the plate of the noise limiter tube, due to the voltage divider action of R150 and R151, and current flows in the tube. This current is modulated by the audio which then appears on the noise limiter cathode to which the grid of the audio amplifier section of V112 is connected. The noise limiter diode will conduct as long as the cathode is negative with respect to the plate.

However, should a heavy noise impulse be received, the plate would be driven negative faster than the cathode could follow due to the time constant of R152 and C205C. If the plate is driven more negative than the cathode, the tube will cease to conduct and no audio will reach the grid of the following audio tube. The audio cannot reach the cathode of the limiter tube directly from the diode load because of the filtering action of R152 and C205C. The value of modulation at which the limiter clips can be adjusted by changing the value of some of the components in the circuit. In this receiver, limiting starts between 50 and 85 percent modulation. Switch S116 bypasses the signal around the noise limiter when receiving conditions do not require its use.

j. AUTOMATIC VOLUME CONTROL. - The pro-

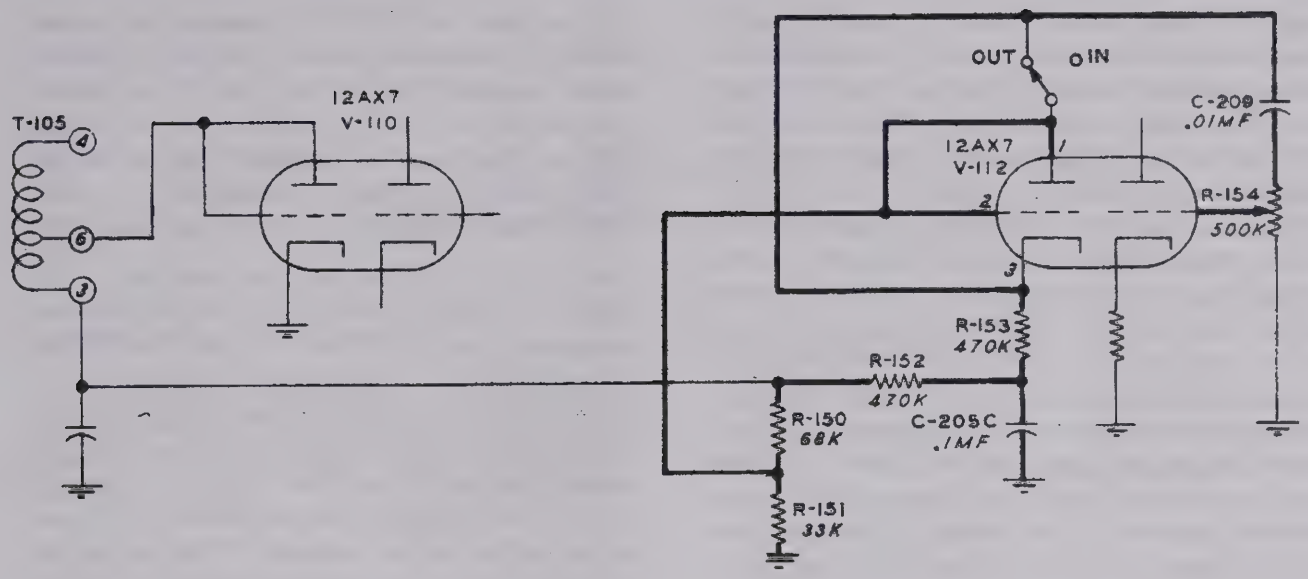


Figure 2-8. Noise Limiter Circuit

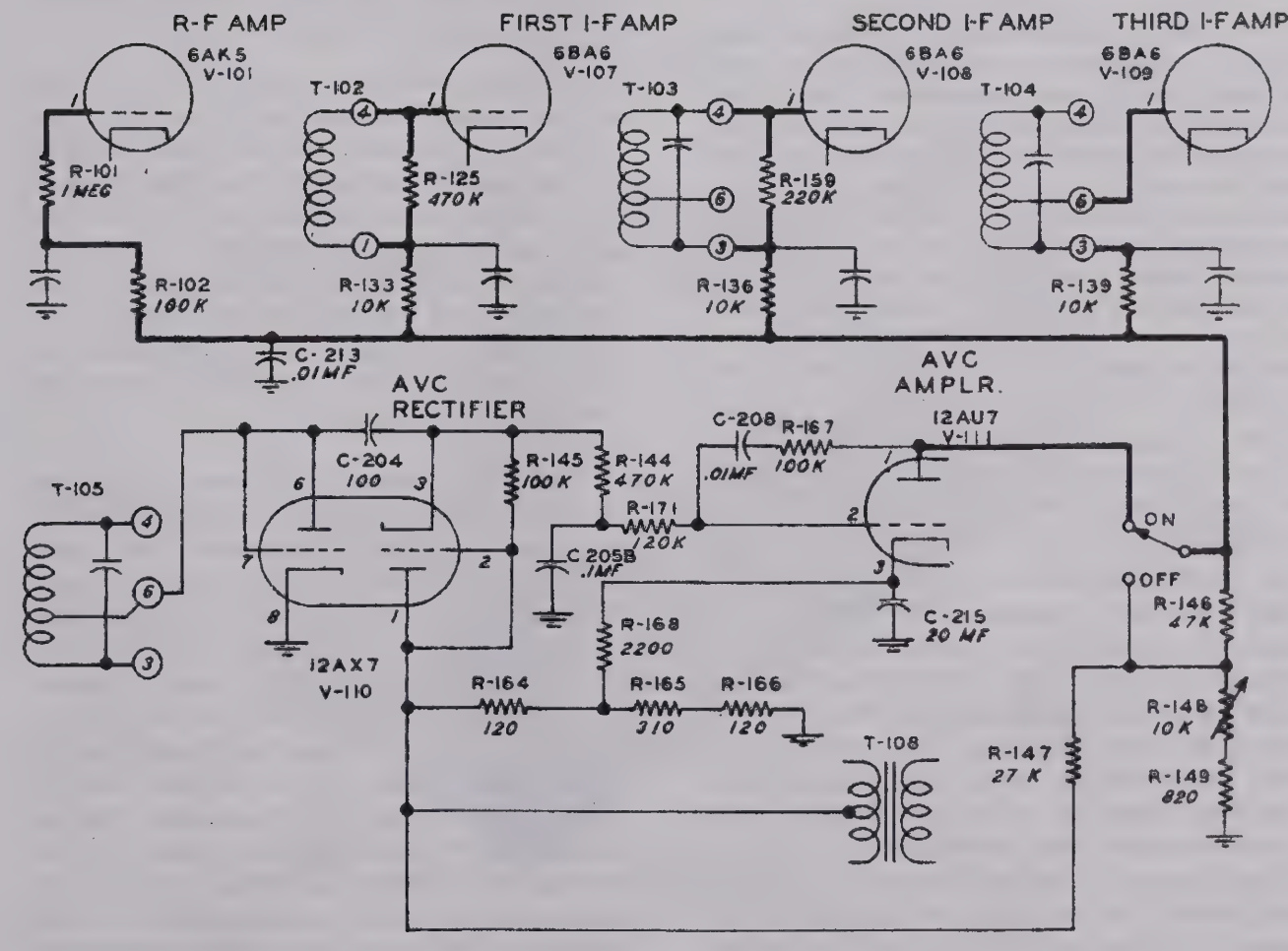


Figure 2-9. AVC Circuit

blem of blocking that is created by strong signals or heavy static is eliminated by use of an amplified avc system and a low impedance avc line. Refer to figure 2-9. The second triode section of V110 is used as an avc rectifier to produce control voltage for the avc amplifier which uses one half of dual triode V111. The avc voltage that is applied to grids of the controlled tubes is produced when plate current flowing through one-half of avc amplifier tube V111 causes a voltage drop across resistor R146. Plate voltage for the amplifier half of V111 is obtained from the voltage drop across resistors R165 and R166, which are in series with the center tap of the power transformer to ground. However, V111 will not draw plate current when there is no signal input to the receiver because of approximately 11 volts of bias that is placed upon its grid by the voltage drop through R164. This bias voltage for V111 is taken from the end of R145, through which the rectified carrier flows in opposition to the bias voltage.

Thus, when the rectified carrier becomes strong enough to overcome the bias voltage on V111, V111 will draw plate current and produce a voltage drop across R146, thereby producing avc voltage in proportion to the strength of the received signal. The bias on the grid of V111 is high enough to produce a delay in the generation of avc voltage and thus allows the receiver to function at full sensitivity on weak signals. Resistor R144 and capacitor C205B form the time constant in the avc circuit. R171, C208, and R167, are used in a degenerative circuit to prevent the avc amplifier tube from responding to low audio frequencies.

Avc is turned off by opening the plate circuit of avc amplifier tube V111. Tubes controlled by avc bias include the r-f amplifier V101 and the 500-kc i-f amplifier tubes, V107, V108, and V109.

k. AUDIO AMPLIFIER. - Two stages of audio amplification are employed in the receiver. The first stage utilizes the second triode section of V112 in a resistance-coupled amplifier arrangement. A miniature pentode power amplifier Tube 6AQ5 is used in the audio output stage. This stage has fixed bias obtained from the voltage drop produced across R166 in the center tap lead of the high voltage transformer secondary. The secondary of the audio output transformer has both 600-ohm and 4-ohm outputs. Both outputs are terminated on the rear of the chassis at terminal strip E102. Plug-in connections to both outputs are also made on the front panel.

l. 50 OHM I-F OUTPUT. - One-half of the dual triode V111 supplies a 50-ohm, 500 kc i-f signal to coaxial connector J104 on the rear of the chassis. This section of V111 is connected as a cathode follower. Excitation is obtained from the voltage drop across R178, which is connected in a series circuit across the secondary of i-f transformer T105.

m. 100-KC CALIBRATOR OSCILLATOR. - This calibrator is included with the receiver for use when extreme accuracy of calibration in the order of 200 cycles is desired. It is coupled to the grid of r-f amplifier tube V101, and is made operable when the CALIBRATE-ON-OFF switch S111 is turned on. The calibrator utilizes a Tube 6BA6 in a Pierce circuit, a low drift 100-kc crystal between the control grid and screen, and a 5-25 uuf capacitor C169 between the grid and ground. The capacitor permits the making of small frequency corrections that set the calibrator to zero beat with a primary frequency standard. Variable capacitor C224 on the front panel provides for fine adjustment of frequencies.

n. BEAT FREQUENCY OSCILLATOR. - The receiver is equipped with a bfo for CW reception. This oscillator is a modified Hartley circuit employing electron coupling. A pentode Tube 6BA6 is used. The output frequency is 500±3 kc, which is beat against the 500-kc if signal to produce an audio tone. Pitch is varied by the BFO PITCH control on the front panel. This control varies the capacitance in the oscillator control grid circuit and thus varies the frequency of oscillation. The BFO is turned off by grounding the screen grid.

o. POWER SUPPLY. - The receiver is equipped with a power transformer that is connected for a 115-volt source. However the transformer can be used on a 230-volt source by re-connecting the primary winding in series. See figure 7-16. The power supply is capable of producing 220 d-c volts at 125 ma. A two-section choke input filter is used following a 5V4 high vacuum rectifier. The filter consists of a 3-henry input choke, a 5-henry output choke, and two 35-mfd-filter capacitors. B+ for the audio output is taken from the junction of the two chokes. The receiver's ON-OFF switch, and a 1.5 ampere, slow-blow fuse are located in the primary circuit of the power supply. 6.3 volts a-c are supplied for the tube filaments and dial lights from a winding on the power transformer.

SECTION 3
INSTALLATION AND INITIAL ADJUSTMENT

1. UNPACKING PROCEDURE.

No special procedure is necessary in unpacking this equipment other than exercising the normal care essential to the safeguarding of electronic equipment. Refer to figure 3-1.

2. INSTALLATION.

The receiver cabinet is designed for table mounting. Outline dimensions of the cabinet and speaker are given in figure 3-2. Cabinet dimensions are: width, 21-1/8 inches; height, 12-3/8 inches; and

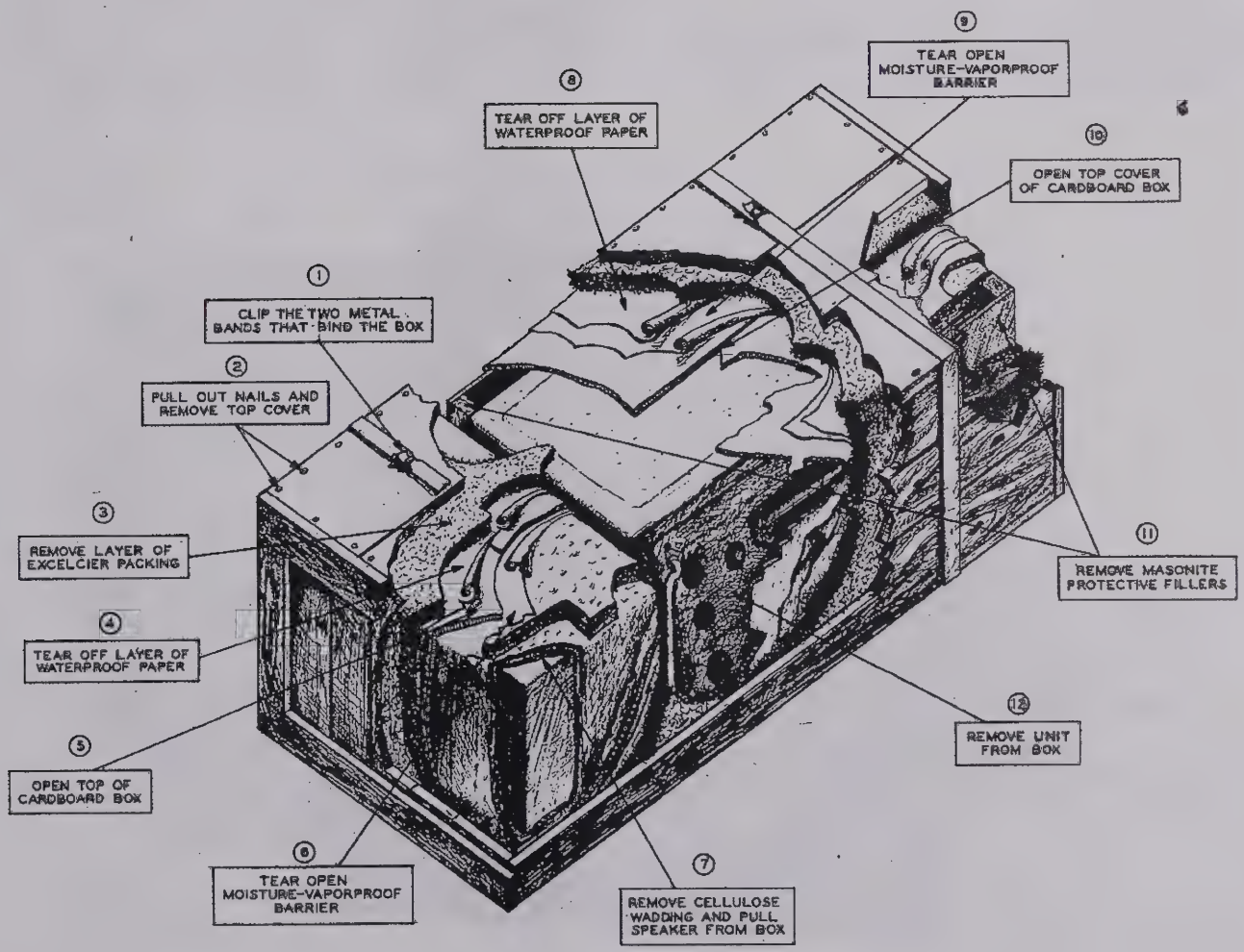

① CLIP THE TWO METAL BANDS THAT BIND THE BOX
② PULL OUT NAILS AND REMOVE TOP COVER
③ REMOVE LAYER OF EXCELCIER PACKING
④ TEAR OFF LAYER OF WATERPROOF PAPER
⑤ OPEN TOP OF CARDBOARD BOX
⑥ TEAR OPEN MOISTURE-VAPORPROOF BARRIER
⑦ REMOVE CELLULOSE WADDING AND PULL SPEAKER FROM BOX
⑧ TEAR OFF LAYER OF WATERPROOF PAPER
⑨ TEAR OPEN MOISTURE-VAPORPROOF BARRIER
⑩ OPEN TOP COVER OF CARDBOARD BOX
⑪ REMOVE MASONITE PROTECTIVE FILLERS
⑫ REMOVE UNIT FROM BOX

Figure 3-1. Unpacking Procedure

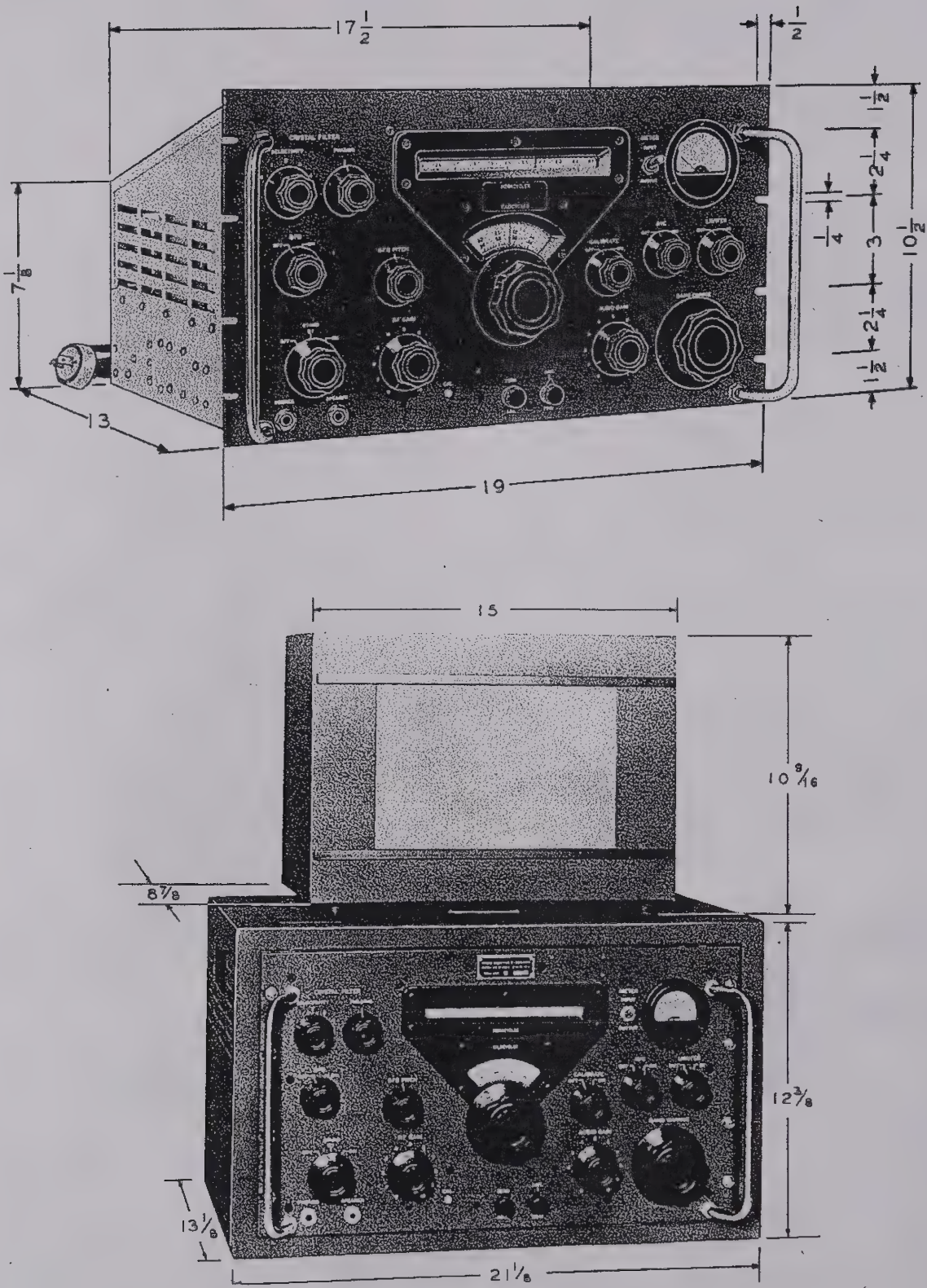


Figure 3-2. Mounting Dimensions

depth, 13-1/8 inches. Speaker dimensions are: width, 15 inches; height, 10-9/16 inches; and depth, 8-7/8 inches.

When choosing a position for the equipment, give consideration to the convenience of power, antenna and ground connections, to placement of cables and to convenience in servicing the equipment. Rear panel connections, shown in figure 3-3, should be accessible without moving the receiver cabinet. Antenna lead and speaker cable lengths are not critical.

a. ANTENNA CONNECTIONS. - Connect a cable from a high impedance whip or a single-ended antenna to antenna jack, J101, on the rear panel. See figure 3-3. If the receiver is to be operated near a powerful transmitter, the r-f input circuit of the receiver should be protected by connecting break-in relay, K101, to operate when the transmitter is radiating. Break-in relay connections and functions are discussed in the following paragraph.

b. REMOTE STANDBY CONNECTIONS. - Break-in relay connections are available at terminal strip E101 at the rear of the chassis. Terminals are marked 1, 2 and 3. Terminal 1 is connected to receiver ground. Terminals 2 and 3 are connected to the break-in relay coil, which is rated at 8.5 d-c volts minimum and 135 ohms d-c resistance. During operation, terminals 2 and 3 are usually connected in series with a source of voltage and a set of normally open contacts on the carrier control relay of a transmitter in order to silence the receiver during transmission. Refer to figure 3-4. When the break-in relay coil is energized, one pair of contacts shorts the antenna to ground; another pair, connected in series with a section of the OFF-STANDBY-ON switch, removes plate voltage from the three i-f amplifier stages. When using the remote relay, place the OFF-STANDBY-ON switch in the ON position. When this switch is placed in STANDBY position, it also removes plate voltage from the three i-f stages and thereby silences the receiver, however,

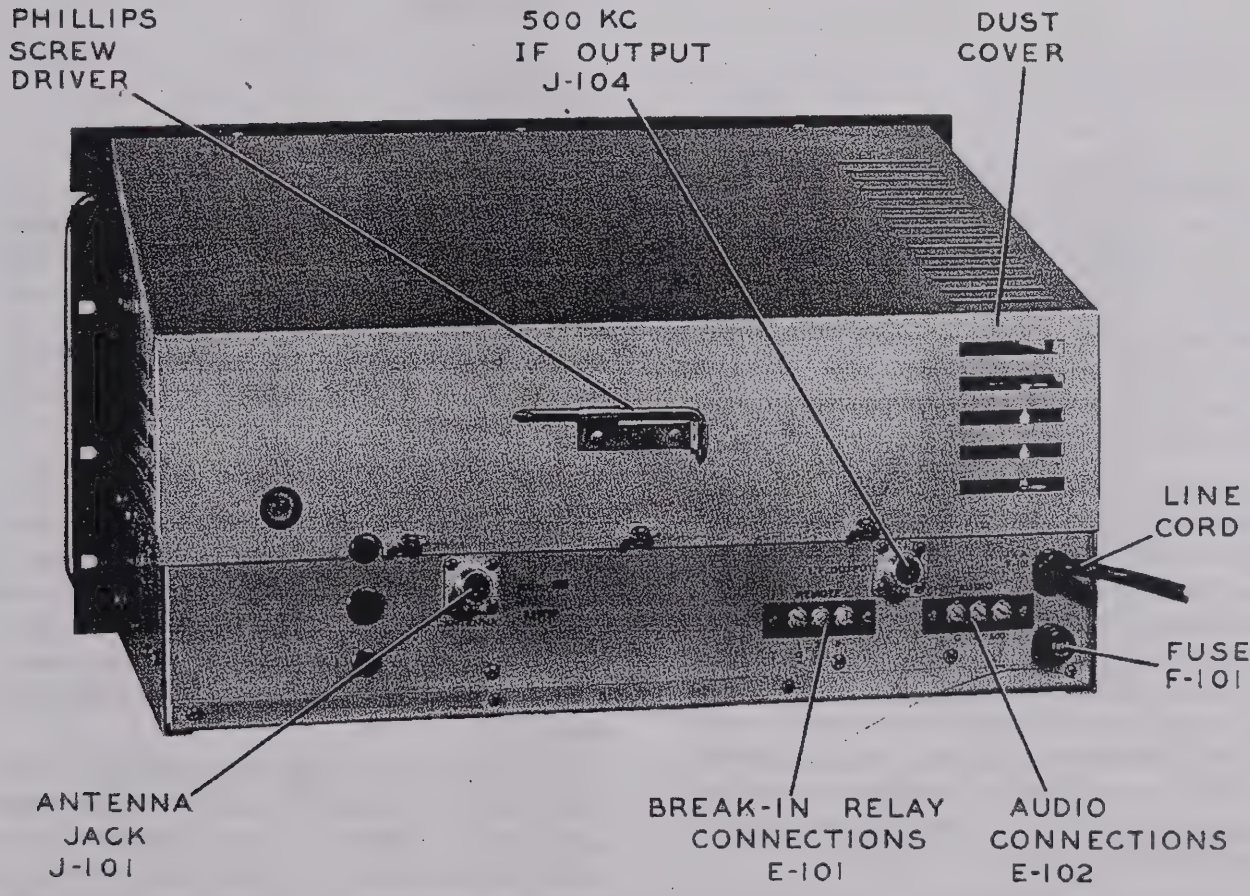


Figure 3-3. Rear Connections

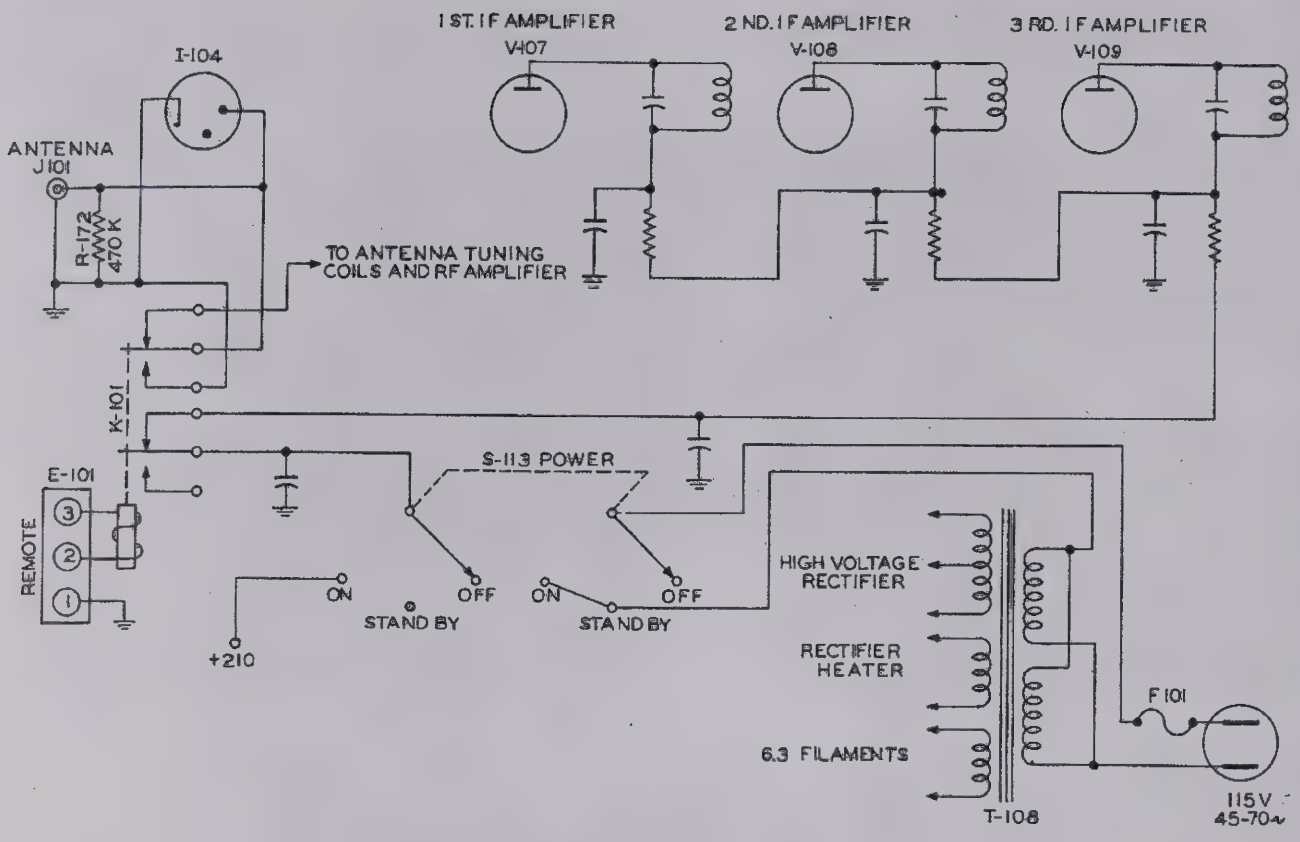


Figure 3-4. On-Off Standby Functions and Remote Operation Relay Circuit

no protection is given the r-f stages since the antenna is not shorted to ground.

c. I-F OUTPUT CONNECTION. - A 100-200 millivolt, 50-ohm, 500-kc i-f output is available at coaxial jack, J104, on the rear panel. This output is available for special applications only, and is not pertinent to normal operation, alignment, or adjustment of this equipment.

d. AUDIO OUTPUT CONNECTIONS. - Two audio output jacks are located on the front panel. One is designated PHONES, and the other SPEAKER. Their output impedances are 4 and 600 ohms respectively. An audio output terminal strip is provided on the rear panel. Terminal G is a ground connection and terminals marked "4" and "600" are audio outputs of four-ohms and 600-ohms impedance respectively. Terminal "4" is connected in parallel with the PHONES jack, and terminal "600" is connected in parallel with the SPEAKER jack. Use these output jacks and terminals as required.

e. POWER CONNECTIONS. - Make power connection by using the rubber covered cord that is permanently attached at the rear of the chassis. This cord is six feet long and is equipped with a standard male plug. The power source must supply 85 watts at 115 volts, 45-70 cps. If 230-volt operation is desired, reconnect the primary coils of T108 by removing the jumpers between terminals 2 and 4 and between 1 and 3; then connect a jumper between terminals 2 and 3.

3. INITIAL INSPECTION AND ADJUSTMENTS.

Before turning on the equipment for the first time, remove the dust cover and make a visual inspection of all tubes. Be certain that they are in their correct positions and well seated in their sockets. Also check for evidences of cracked or broken parts and general damage which might have been inflicted during shipment.

This equipment is completely tested and aligned before leaving the factory. A few initial adjustments in the form of operational checks should be made before actual operation. These are outlined in Section 4, paragraph 3. (OPERATIONAL TUNING ADJUSTMENTS).

SECTION 4
OPERATION

1. FUNCTION OF CONTROLS.

Operation of the receiver is exceedingly simple if the functioning of the controls is understood. The following paragraphs explain the functions of controls on the receiver's front panel. See figure 4-1.

a. OFF-STANDBY-ON. - In the OFF position, this control opens the primary power circuit to turn the equipment completely off. In the STAND-BY position the power transformer is excited, thus producing filament voltage for all stages and plate voltage for all except the three i-f amplifier stages. In the ON position the receiver is completely operative.

b. RF GAIN. - The RF GAIN control is located in the grid return circuit of the avc controlled tubes and is operative at all times. It varies the amount of fixed bias placed upon the grids of these tubes.

c. AUDIO GAIN. - The AUDIO GAIN control is located in the grid circuit of the first audio amplifier and is operative at all times. It varies the amount of

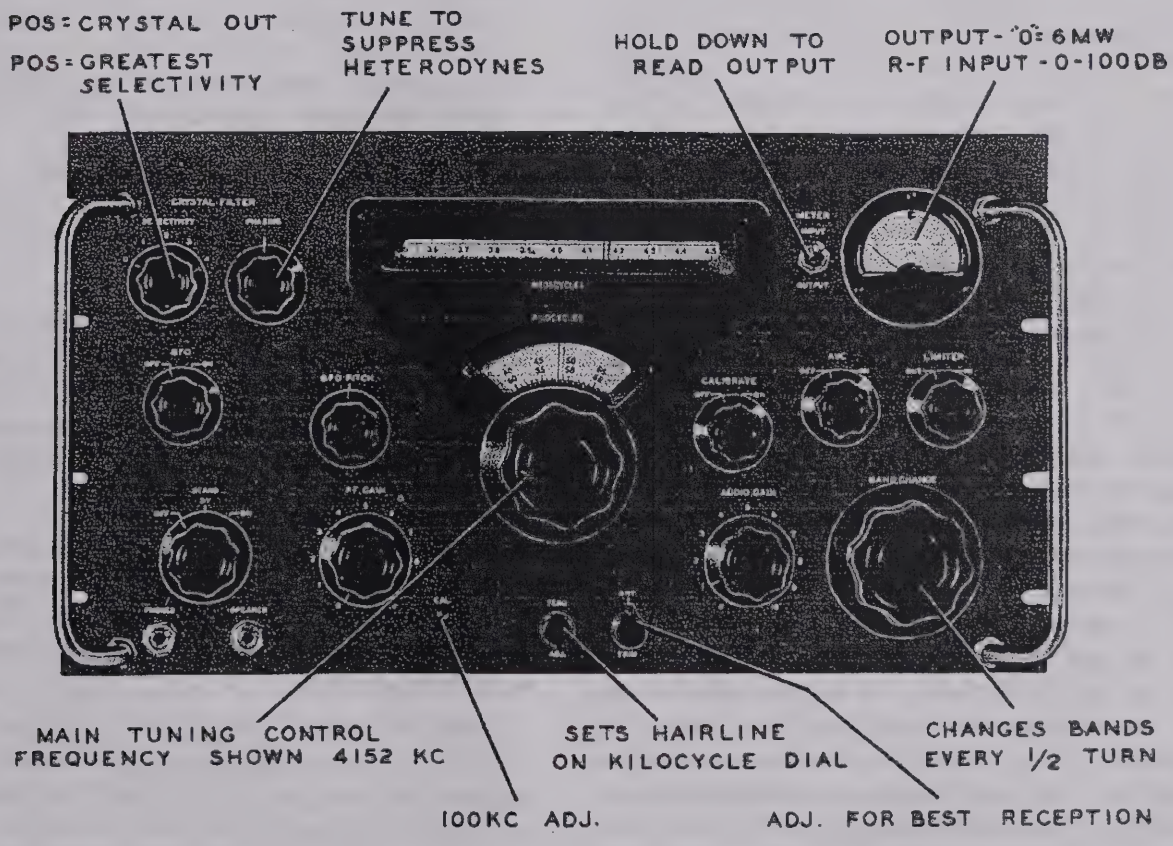


Figure 4-1. Operating Controls

a-f signal applied to the grid of this tube, and thereby controls the amount of audio power produced by the receiver.

d. BAND CHANGE. - Any one of the 30 bands may be selected at 1/2 revolution intervals by means of this knob. A stiff detent accurately positions the controlled switches on each band.

e. MEGACYCLE. - The MEGACYCLE scale is on the slide-rule type dial. It is calibrated in ten 100-kc divisions, each of which equals one full turn of the circular KILOCYCLE dial. The 1.5 to 2.5-mc and 2.5 to 3.5-mc bands are printed in red, indicating that the red scale on the KILOCYCLE dial must be used when operating on these bands. The pointer-on the MEGACYCLE dial is operated by the KILOCYCLE control while the scale is changed by operation of the BAND CHANGE control.

f. KILOCYCLE. - The KILOCYCLE dial is the main tuning control on the receiver. Each division on its circular face represents one kilocycle. One full turn of the dial tunes the receiver through 100 kilocycles, or one division of the MEGACYCLE scale. To read the tuning dials, merely combine the figures of the MEGACYCLE dial with those of the KILOCYCLE dial, thus arriving at the frequency in kilocycles. For example, a reading of 14.1 on the MEGACYCLE dial and of 78 on the KILOCYCLE dial indicates a frequency of 14178 kc. The KILOCYCLE scale for the 1.5 to 2.5 and 2.5 to 3.5 mc bands is in reverse order to the scale for the rest of the bands, and is printed in red similar to corresponding scales on the MEGACYCLE dial.

g. ZERO ADJ. - The ZERO ADJ moves the indicator line on the KILOCYCLE control a few divisions in either direction for calibration purposes. The receiver may be calibrated against either any receivable station whose frequency is known or the internal calibration oscillator. This oscillator emits a harmonic every 100 kc in the tuning spectrum. An example of how the receiver may be calibrated using this oscillator follows. If the desired signal is about 14100 kc, turn the 100 KC CRYSTAL ON and the BFO ON with BFO PITCH control at panel mark. Next, using the KILOCYCLE knob, tune to zero beat with the 100-kc marker at 14100 kc. Then move the ZERO ADJ control until the hair line is exactly on 14100 kc. The dial reading in this region is now very accurate, and the receiver may be set within a few hundred cycles of the desired frequency.

NOTE

WHEN READING THE FREQUENCY OF AN INCOMING SIGNAL, THE BFO PITCH CONTROL MUST BE LEFT IN THE SAME POSITION AS IT WAS WHEN THE RECEIVER WAS CALIBRATED.

A ten division scale (five divisions either side of center) is engraved on the lower edge of the excutcheon opening for the KILOCYCLE dial, and is used to log the calibrated position of the hair line on the various bands in lieu of recalibrating each time the band is used.

h. METER INPUT-OUTPUT. - The METER switch is a momentary spring-return type toggle switch. In the normal or INPUT position the meter is connected as an S meter. In the OUTPUT position, the meter is connected in the audio output circuit as a db meter.

CAUTION

NEVER DEPRESS THE METER SWITCH TO OUTPUT POSITION WHEN AUDIO GAIN IS SET FOR SPEAKER OPERATION. THE OUTPUT METER LEVEL IS VERY LOW AND DAMAGE TO THE MOVEMENT MAY RESULT FROM EXTREME OVERLOAD.

i. BFO OFF-ON. - In the ON position this control turns ON the beat frequency oscillator for CW reception. In the OFF position, it grounds the screen grid of the bfo tube.

j. BFO PITCH. - The BFO pitch control varies the frequency of the beat frequency oscillator to change the pitch of the audio tone which is produced by combining the bfo signal with the incoming signal. A range of about ±3 kc minimum can be obtained with this control.

k. CALIBRATE OFF-ON. - This switch is in the cathode circuit of 100 kc crystal oscillator tube V104 and turns the 100-kc oscillator to ON or OFF. For an explanation of how to use the oscillator, see paragraph g. above.

l. AVC OFF-ON. - This switch turns AVC to ON or OFF. In most cases AVC should be ON for both AM and CW reception, but may be turned OFF for CW reception if desired.

m. LIMITER OUT-IN. - The noise limiter is useful for both AM and CW reception. When noise is

not a problem, turn the LIMITER to OFF, as the distortion will be less in this position. When noise of the impulse type is being received, turn the LIMITER to ON. Adjustment of RF and AF gain controls is necessary for best CW noise limiting.

n. CRYSTAL FILTER.

(1) SELECTIVITY. - In position 0 of this control, the crystal filter is not used and selectivity is determined by the receiver's tuned circuits alone. In positions 1 through 4, the crystal filter is in the circuit, the selectivity being increased as position 4 is approached. Position 4 gives a bandwidth of about 200 cps at 6 db down.

(2) PHASING. - The PHASING control is used to reject unwanted heterodynes. When positioned on the panel mark, the control is properly set for crystal phasing with no rejection notch. If a high frequency heterodyne is interfering with reception, move the control back and forth near the panel mark until the heterodyne is attenuated. If the heterodyne is of lower frequency, move the control farther to left or right of the panel mark. This control will attenuate heterodynes ranging from 1 to 3 kc.

o. METER. - The tuning meter is calibrated in 20, 40, 60, 80 and 100 db above avc threshold when reading r-f input. When reading audio output, the meter is calibrated from -10 to +6 db, zero reference being 6 milliwatts into a 500 ohm load.

p. CAL. - If supreme accuracy is desired, the frequency of the 100-kc oscillator should be checked against WWV or some other station whose frequency is known to be extremely accurate. This oscillator frequency may be varied through small limits by turning the CAL control with a screw driver. Additional range can be obtained by turning C169, located just behind the 100 kc crystal.

q. ANTENNA TRIM. - This control has a limited effect on matching the antenna impedance to the r-f amplifier grid circuit at various signal frequencies. It is adjusted to obtain the best response at a given frequency. Proper setting can be obtained by peaking the S meter when tuned to a station. This control may not have sufficient range for this peak adjustment at all frequencies but the receiver sensitivity is such that no appreciable unsatisfactory reception will be noted if the antenna cannot be perfectly tuned.

2. OPERATION - CW AND A.M.

Operation of the receiver provides for reception of either modulated CW or amplitude-modulated signals. Procedure in either case is as follows.

a. For reception of amplitude-modulated signals, proceed as follows: Turn OFF-STANDBY-ON switch to ON. Turn AVC on. Turn CALIBRATE OFF-ON switch to OFF. (The calibrator oscillator is used only in calibration of the tuning dials.) Turn the BFO off. Then select the desired band by means of the BAND SWITCH, and turn the KILOCYCLE tuning knob to read the desired frequency. Adjust the RF GAIN and the AUDIO GAIN controls for best reception. The LIMITER can be turned on if noise persists and interfering signals can be eliminated by placing the SELECTIVITY switch in the various positions (selectivity increasing with position numbers). Should unwanted heterodynes be interfering with reception, adjustment of the CRYSTAL PHASING control will suppress heterodynes ranging from 1 to 3 kc.

b. For reception of CW signals, procedure is as above with the exception that the BFO is turned on and the BFO PITCH control varied for the desired audio pitch.

3. OPERATIONAL TUNING ADJUSTMENTS.

Alignment and adjustment of the BFO PITCH and CRYSTAL PHASING controls should not be attempted without proper test equipment. Such adjustments are covered in detail in Section 7 (CORRECTIVE MAINTENANCE). However, the operator may make operational adjustments which require no test equipment as follows.

a. ZEROING S METER.--Ordinarily this meter will not need zeroing until component part tolerances have drifted, receiver alignment has been changed, or new component parts placed in the receiver. However, should the meter become sufficiently out of zero adjustment that weak signals show little or no response on the meter, it may be adjusted by the operator as follows.

Remove receiver from cabinet or rack. Remove antenna cable and short antenna terminals. Turn the receiver ON, BFO Off, AVC On, and 100 KC CRYSTAL OFF; then turn the RF GAIN fully clockwise.

The meter should read zero with these settings. If not, turn the meter zeroing control until the meter reads zero. The location of this control is shown in figure 7-2. Normally, this adjustment need not be made by the operator unless tube replacements have been made by the operator, at which time the zeroing adjustment control would be accessible and the meter zero should be checked.

b. KILOCYCLE DIAL ZERO ADJUST. - A frequently made pre-operational adjustment to be made by the operator is that of calibrating the receiver dials against a known frequency or against the 100 KC CALIBRATION OSCILLATOR. A station of known frequency may be used for this adjustment by turning the BFO on, setting BFO pitch to 500-kc and zero beating the receiver signal with the BFO. If the dial reading at this point is not correct, the indicator line on the KILOCYCLE dial may be moved to the correct position on the dial by means of the ZERO ADJUST. knob on the front panel.

The 100-KC CALIBRATION OSCILLATOR may be used for properly calibrating the dial by turning the CALIBRATE control on and the BFO on. Set BFO at panel mark (500kc). A series of zero beats will be heard at every 100-kc point on the dial. The KILOCYCLE dial reading at any of these 100-kc checkpoints should be 0-0; if not, the indicator line may be moved a few divisions by means of the ZERO ADJUST. knob.

In either of the above methods, should the dial reading be off more than ±5 kc from the correct point, additional dial alignment will have to be performed. See Section 7 (CORRECTIVE MAINTENANCE).

c. 100-KC CALIBRATION OSCILLATOR ADJUSTMENT. - By means of the CAL control on the front panel, the frequency of the 100-kc oscillator can be varied through a small range. When supreme accuracy is desired in setting the dials, the frequency of the calibration oscillator should be checked against a station whose frequency is known to be accurate. Station WWV offers a means of calibrating the 100-kc oscillator directly.

The receiver is carefully tuned to one of WWV's channels with the BFO off. The CALIBRATE control is turned on, and by means of the CAL. control, the frequency of the calibration oscillator is adjusted to zero beat with WWV at the time when WWV is not modulating its carrier. Consult WWV's schedule for transmission frequencies and types of transmission.

For best results, the relative signal strengths of the 100-kc oscillator and the WWV carrier should be the same. The receiver should be tuned to other WWV frequencies if the one originally chosen is not of sufficient strength to give a zero beat. Several should be tried to obtain the one which gives the most desirable signal strength.

If difficulty in obtaining a beat between the two signals is encountered, no adjustment of the CAL. control should be attempted. Should a definite beat be heard, the CAL. adjustment can be made for the best zero beat indication. Additional aid in obtaining the correct setting of the CAL control may be had by turning the BFO on and further adjusting for elimination of a resulting rise and fall of intensity (not tone) of the beat.

d. ANTENNA TRIM ADJUSTMENT. - This control is used to match the antenna impedance to the grid of the first r-f amplifier stage as the receiver is tuned over the band range available. This control should be adjusted for maximum receiver response by peaking the S meter. The effect of the adjustment is limited and may not have sufficient effect for absolute matching over the entire frequency spectrum. However, the receiver sensitivity is high enough such that a small mismatch will not appreciably interfere with good reception.

SECTION 5

OPERATOR'S MAINTENANCE

1. ROUTINE CHECK CHARTS

During normal operation of the receiver, the operation of the basic functioning of the set should be checked as in Table 5-1.

TABLE 5-1 ROUTINE CHECK CHART, EACH WATCH

WHAT TO CHECK	HOW TO CHECK
1. BFO	Turn BFO to ON position and observe whether beat is heard.
2. BFO PITCH	Vary BFO Pitch control with BFO on and observe variation in pitch of audio beat.
3. 100 KC Calibration Osc.	Turn CALIBRATE control to ON and adjust tuning dials for peak on input meter at 100 kc checkpoints.
4. HFO Crystals	Check for 100-kc checkpoint peaking on S meter at a minimum of one position on bands 1, 4, 5, 7, 9, 11, 15, 19, 23, and 29. This will check the operation of each of the ten crystals employed in the HFO.
5. AUDIO GAIN	Check to see that the audio output increases when audio gain is turned clockwise. Can be checked on meter in OUTPUT position.
6. RF GAIN	Check to see that the r-f input as observed on the INPUT METER varies as the RF GAIN control is varied.
7. DIAL ALIGNMENT (ZERO SET)	Check the dial readings against a 100-kc checkpoint with CALIBRATE ON. At these checkpoints the KILOCYCLE dial should read 0.0. If not, adjust reading line with ZERO SET knob on front panel.

2. FUSE LOCATION AND SYMPTOMS OF FAILURE.

The fuse, F101, is located on the rear of the chassis.

CAUTION

NEVER REPLACE A FUSE WITH ONE OF HIGHER RATING UNLESS CONTINUED OPERATION OF THE EQUIPMENT IS MORE IMPORTANT THAN PROBABLE DAMAGE. IF A FUSE BURNS OUT IMMEDIATELY AFTER REPLACEMENT, DO NOT REPLACE IT A SECOND TIME UNTIL THE CAUSE OF TROUBLE HAS BEEN CORRECTED.

FUSE SYMBOL AND VALUE	FUNCTION	SYMPTOMS OF FAILURE
F-101 1-1/2 amp	Power Supply Protection (115 V or 230 V)	Complete operational failure. No panel or tube filaments lighted

3. REPLACEMENT OF ELECTRON TUBES.

a. LOCATION. - All tubes are accessible from the top of the receiver chassis after dust cover removed. Figure 5-1 shows the tube layout on the chassis.

b. PRECAUTIONS. -

(1) Remove tubes by pulling them straight up.

(2) Before inserting a tube, make certain that the pins are straight and that it is of the correct type for the socket into which it is to be placed.

4. REPLACEMENT OF PILOT LAMPS.

The lights for the slide rule dial are mounted in sockets which are clipped to the metal structure above the dial. To replace light bulbs, slide the clips off the metal structure and pull out the sockets. Exert a slight down-pressure on the bulb and turn bulb slightly counter clockwise to release. When replacing the sockets, press the wires up into the channel.

To remove the KILOCYCLE dial bulb, reach under the drum of the MEGACYCLE drum and grasp the dial light socket; then pull it back far enough to replace the bulb.

The lamp designations and other nomenclature are related as follows:

LAMP			SOCKET DESIGNATION	BULB TYPE	BASE
DESIGNATION	VOLT	AMP			
I-101	6.3	0.15	XI - 101	T - 3-1/4	Min. Bayonet
I-102	6.3	0.15	XI - 102	T - 3-1/4	Min. Bayonet
I-103	6.3	0.15	XI - 103	T - 3-1/4	Min. Bayonet

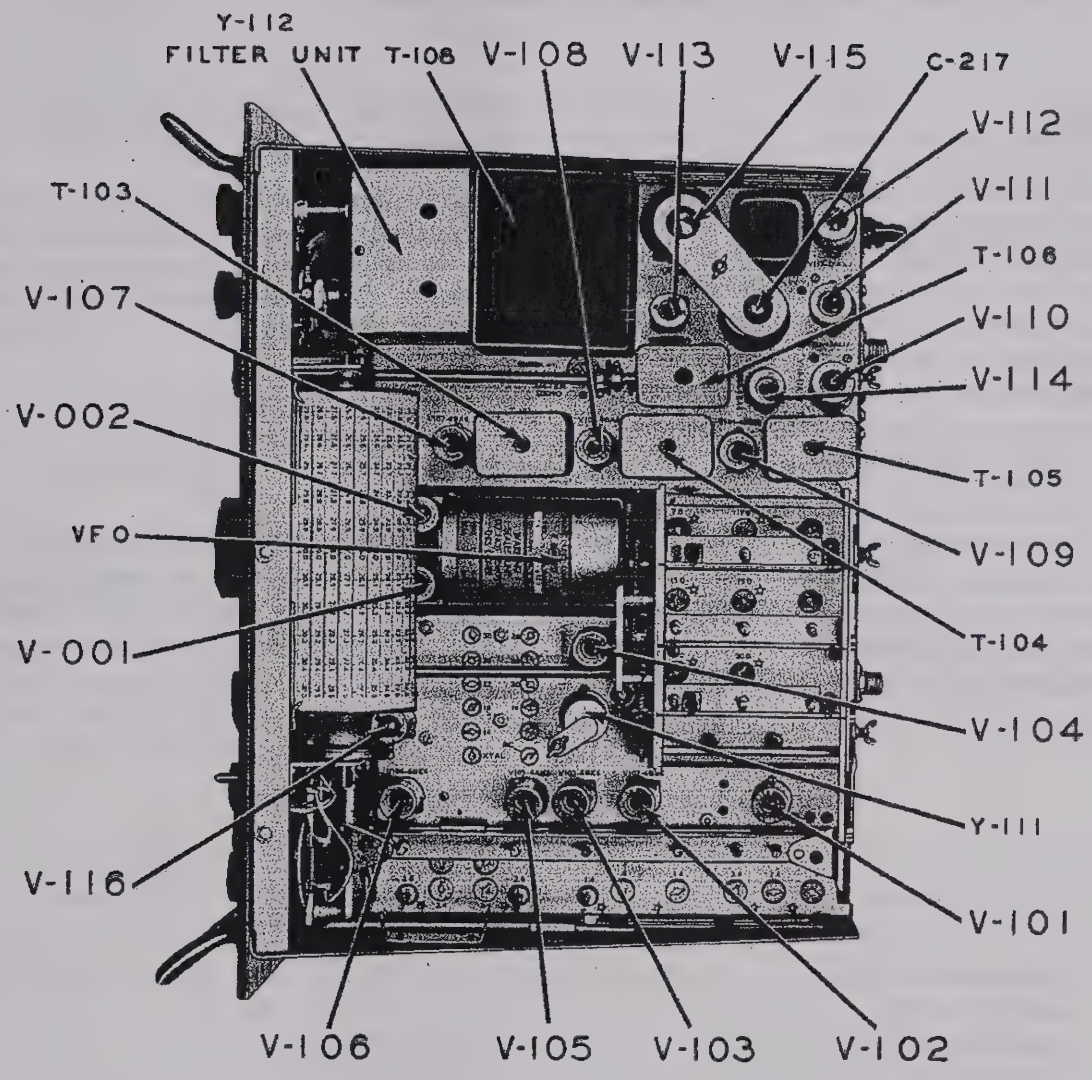


Figure 5-1. Top View, Tube and Parts Identification

SECTION 6
PREVENTIVE MAINTENANCE

1. GENERAL.

A certain amount of checking and servicing is necessary to maintain efficient and dependable operation of any type of electronics gear. Preventive maintenance in the form of periodic checks upon the mechanical and electrical systems of this receiver is just as important as corrective maintenance. If routine inspection of the equipment is carried out faithfully, the chances of improper operation of the equipment are greatly minimized.

The worst enemies of uninterrupted service in equipment of this type are dirt and corrosion. Dirt reduces efficiency and causes undue wear of rotating parts. Corrosion most seriously affects contacts such as those on tap switches, tubes, relays and cable. Salt-laden air, dirt, and moisture accelerate corrosion. The result may be equipment failure for no apparent reason.

Under certain conditions it is difficult or virtually impossible to prevent accumulation of moisture. Even so, frequent wiping of parts lessens danger of corrosion. If the atmosphere is corrosive, frequent inspection and wiping of parts is of special importance.

2. ROUTINE MECHANICAL AND ELECTRICAL CHECKS.

NOTE

THE ATTENTION OF MAINTENANCE PERSONNEL IS INVITED TO THE REQUIREMENTS OF CHAPTER 67 OF THE "BUREAU OF SHIPS MANUAL", OF THE LATEST ISSUE.

TABLE 6-1 ROUTINE MAINTENANCE CHECKS

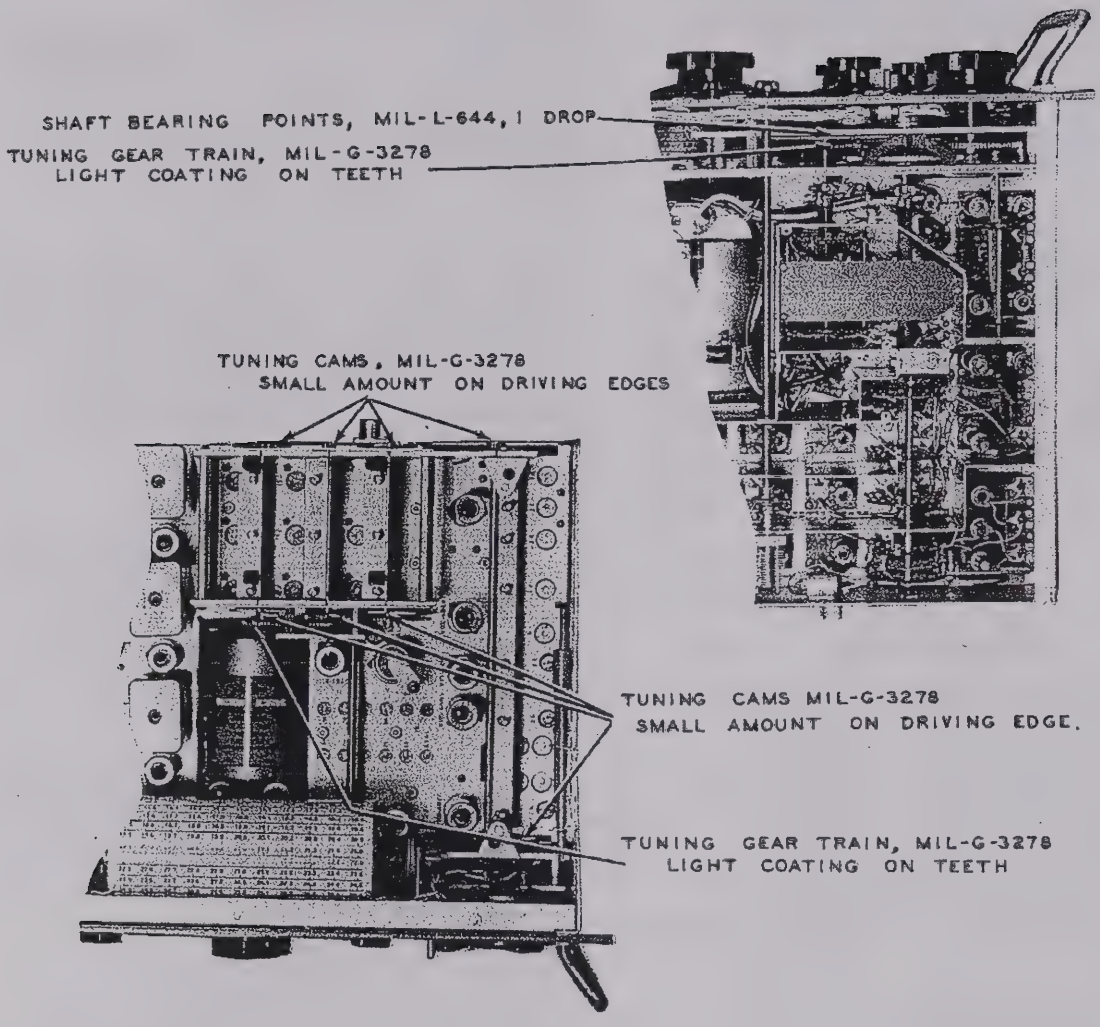
	WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS AND REMEDIES
DAILY	1. Accumulation of dust and dirt on front panel and rear terminal connections.	Visual inspection	Remove with a soft brush or rag.
WEEKLY	1. Components inside receiver	Remove receiver from cabinet and remove dust cover. Check for dust, dirt, corrosion, and evidences of overheating in components.	Clean with soft brush or dry, oil-free jet of air. Check components showing evidences of overheating and replace if necessary.
	2. Rotary contacts and switch contacts	Inspect for loss of tension, poor contacts, or evidences of pitting and corrosion.	Clean, repair, or replace as needed. Crocus cloth or carbon stoddard solvent may be used.

TABLE 6-1. ROUTINE MAINTENANCE CHECKS, CONT.

	WHAT TO CHECK	HOW TO CHECK	PRECAUTIONS AND REMEDIES
WEEKLY	3. Antenna remote relay contacts	Check for evidences of pit marks, uneveness of contacts, or corrosion.	Remedy with burnishing tool and stoddard solvent.
MONTHLY	1. Tuning shafts, cams, and gears	Make visual inspection while rotating each tuning control through entire range.	Clean with carbon tetra-chloride if dirty and apply lubrication when necessary.
	2. Tube sockets and crystal sockets	Examine socket contacts	Replace if cracked or broken.
		Check for cracked or broken sockets	Replace.
		Examine tube and crystal pins or contact area for corrosion.	Remove with crocus cloth and stoddard solvent.
	3. Electron tubes	Check emission	Replace if necessary

3. LUBRICATION.

Under normal operating conditions, very little lubrication is necessary. Figure 6-1 indicates those parts of the tuning mechanism which should receive a very minimum amount of lubrication when needed. The need for lubrication can in general be ascertained by visual inspection or an indication of mechanical binding. No specific period is recommended as the need for lubrication will vary immensely with the type of operation.


SHAFT BEARING POINTS, MIL-L-644, 1 DROP
TUNING GEAR TRAIN, MIL-G-3278
LIGHT COATING ON TEETH
TUNING CAMS, MIL-G-3278
SMALL AMOUNT ON DRIVING EDGES
TUNING CAMS MIL-G-3278
SMALL AMOUNT ON DRIVING EDGE.
TUNING GEAR TRAIN, MIL-G-3278
LIGHT COATING ON TEETH

NAVY LUBRICANT		STANDARD NAVY STOCK NUMBER								
Specification	Title	4 oz.	8 oz.	1 lb.	5 lb.	25 lb.	35 lb.	100 lb.	1 qt.	5 gal.
MIL-G-3278	Aircraft and Instrument Grease		R14-G-984-500	R14-G-982-20	R14-G-984-520	R14-G-984-540	R14-G-984-550	R14-G-984-560		
MIL-L-644	Special Preservative Lubricating Oil	W14-0-2833-944							W14-0-2834-10	W14-0-2834-15

Figure 6-1. Lubrication Data-Radio Receiver R/388/URR-23A

SECTION 7
CORRECTIVE MAINTENANCE

1. INTRODUCTION.

The two-fold purpose of any corrective maintenance procedure is to sectionalize the faulty stage or circuit, then to localize the faulty component in the defective stage for circuit. The maintenance technician should familiarize himself with the overall operation of the equipment prior to servicing. Reference to schematics and wiring diagrams should be made frequently to aid in servicing.

Necessary repairs should be made by competent radio technicians, supplied with suitable tools and equipment.

In making all repairs and replacements, try to duplicate the original condition of the equipment. Use standard replacement parts, such as those supplied in the spare parts accompanying this equipment or parts taken from stock. Take care to run replacement wiring in the same position and manner as the original wiring. When soldering use resin-core solder only. Use only enough to make a good mechanical and electrical connection. Remove excess solder that may have dropped on other components.

In the case of temporary emergency repairs, where exact replacement of parts is not possible, conspicuously tag the equipment so repaired to indicate the temporary nature of the repair, and restore it to its original condition at the first possible opportunity.

2. LOCALIZATION OF TROUBLE.

A definite system of localizing trouble is necessary for prompt and efficient maintenance. In some cases, trouble may be localized by observing the operation of panel controls. Check these controls and accessible components such as vacuum tubes, which are a major source of electronic troubles, before proceeding to any intricate servicing.

In this receiver, the best means of localizing trouble is through signal tracing. Having localized the faulty stage, check the tubes involved. If the tubes are not faulty, systematically check the defective circuit and its associated components for continuity, defective resistors, shorted capacitors, loose connections, etc. Use test equipment such as as ohmmeter or electronic voltmeter for these checks.

When performing circuit continuity checks or resistance measurements, make careful reference to schematics in order to take into account other components which may be shunted with the part under test. For accurate results, disconnect one lead of the part being checked before proceeding with measurements. Make full use of all schematic diagrams and troubleshooting charts contained in Section 7.

The following RECEIVER FAILURE CHART Table 7-1 lists some of the more obvious failures and possible remedies. Signal tracing by means of a signal generator and voltmeter or headset for output indication will be of considerable aid in the localization of troubles. Also, complete voltage and resistance checks in suspected circuits will aid in locating faulty circuit components. (See figure 7-1).

Overall weak performance would suggest that the receiver is out of alignment. Complete alignment procedures follow in this section. Final receiver testing is outlined in paragraph 4. m. of this section.

FAILURE REPORTS

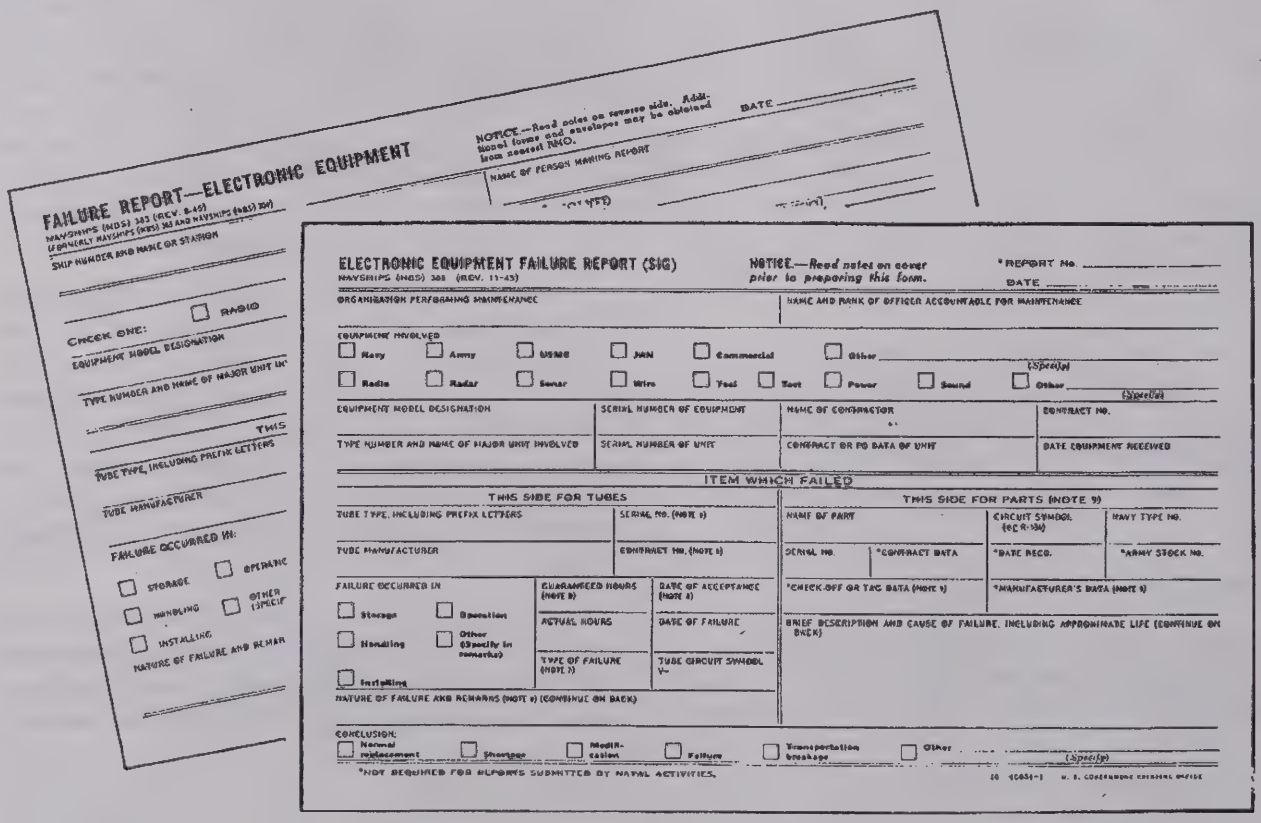
A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NBS-383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS in the franked envelope which is provided. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example, under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T-803, in the case of a transformer, or R-207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completly describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards, and envelopes on board. They may be obtained from any Electronics Officer.


FAILURE REPORT—ELECTRONIC EQUIPMENT

NOTICE.—Read notes on reverse side. Additional forms and envelopes may be obtained from nearest NAO.

DATE

NAME OF PERSON MAKING REPORT

SHIP NUMBER AND NAME OR STATION

CHECK ONE: RADIO

EQUIPMENT MODEL DESIGNATION

TYPE NUMBER AND NAME OF MAJOR UNIT IN

THIS TUBE TYPE, INCLUDING PREFIX LETTERS

TUBE MANUFACTURER

FAILURE OCCURRED IN:

STORAGE OPERATING

HANDLING OTHER (SPECIF

INSTALLING

NATURE OF FAILURE AND REMAR

ELECTRONIC EQUIPMENT FAILURE REPORT (SIG)

NAVSHIPS (NBS) 383 (REV. 11-43)

NOTICE.—Read notes on cover prior to preparing this form.

*REPORT NO.

DATE

ORGANIZATION PERFORMING MAINTENANCE

NAME AND RANK OF OFFICER ACCOUNTABLE FOR MAINTENANCE

EQUIPMENT INVOLVED

Navy Army USMC JAN Commercial Other (Specify)

Radio Radar Sonar Wire Test Set Test Power Sound Other (Specify)

EQUIPMENT MODEL DESIGNATION | SERIAL NUMBER OF EQUIPMENT | NAME OF CONTRACTOR | CONTRACT NO.

TYPE NUMBER AND NAME OF MAJOR UNIT INVOLVED | SERIAL NUMBER OF UNIT | CONTRACT OR PO DATA OF UNIT | DATE EQUIPMENT RECEIVED

ITEM WHICH FAILED

THIS SIDE FOR TUBES

TUBE TYPE, INCLUDING PREFIX LETTERS | SERIAL NO. (NOTE 1)

TUBE MANUFACTURER | CONTRACT NO. (NOTE 1)

FAILURE OCCURRED IN: Storage Operation Handling Other (Specify in remarks) Installing

GUARANTEED HOURS (NOTE 2) | DATE OF ACCEPTANCE (NOTE 2)

ACTUAL HOURS | DATE OF FAILURE

TYPE OF FAILURE (NOTE 3) | TUBE CIRCUIT SYMBOL V-

NATURE OF FAILURE AND REMARKS (NOTE 4) (CONTINUE ON BACK)

THIS SIDE FOR PARTS (NOTE 5)

NAME OF PART | CIRCUIT SYMBOL (EG R-104) | NAVY TYPE NO.

SERIAL NO. | *CONTRACT DATA | *DATE RECD. | *ARMY STOCK NO.

*CHECK-OFF OR TAC DATA (NOTE 6) | *MANUFACTURER'S DATA (NOTE 6)

BRIEF DESCRIPTION AND CAUSE OF FAILURE, INCLUDING APPROXIMATE LIFE (CONTINUE ON BACK)

CONCLUSION: Normal replacement Shortage Modification Failure Transportation breakage Other (Specify)

*NOT REQUIRED FOR REPORTS SUBMITTED BY NAVAL ACTIVITIES.

16 45684-1 U. S. GOVERNMENT PRINTING OFFICE

Failure Report, Sample Form

TABLE 7-1 RECEIVER FAILURE CHART

SYMPTOM	PROBABLE CAUSE	CORRECTION
Set completely dead. No panel lights or filaments lighted.	Set not plugged in.	Connect P-101 to 115-v or 230-v source according to primary winding hookup in power transformer.
	Power fuse blown.	Replace F-101
	Power switch S113 defective.	Check contacts and operation of switch.
Panel lights and filaments lighted, but no plate volts.	Power rectifier tube faulty.	Replace tube V115.
Fuse blows whenever set is turned to ON position	H.V. rectifier circuit defective	Check V115, C207, filter capacitor C217A, C217B.
	Short in plate or screen voltage lines.	Check for shorts in all plate and screen circuits.
No audio output--no reading on input meter or output meter. R-f amplifier, vfo and hfo operative. Crystal filter out.	No plate voltage on fixed i-f stages, V107, V108, V109. See figure 3-3.	Check relay contacts on K101.
		Check contacts on power Switch, S113.
	Faulty i-f amplifier circuits, V107, V108, and V109	Check tubes. Make voltage and resistance checks in these stages.
	I-f transformers badly out of alignment.	See FIXED 500-kc IF alignment procedure in paragraph 4.c., this section.
Same as above, but crystal filter in.	Crystal filter not passing 500 kc.	Replace 500-kc crystal, Y112, in filter unit.
I-f and audio O.K. Weak reception on Even Numbered bands.	1.5 to 2.5 mc variable i-f misaligned.	Align as in section 7, paragraph 4.j.(2).(a).
I-f and audio O.K. Weak reception on Odd Numbered bands.	2.5 to 3.5 mc variable i-f misaligned.	Align as in section 7, paragraph 4.j.(2).(b).
Overall weak reception.	Band antenna connections	Check antenna connections for dirt and corrosion.
	R-f amplifier or 2nd Mixer stages bad	Check V101 and V106 circuits for bad tubes.
		Make voltage and resistance checks in these stages.
	Overall alignment is bad.	Check alignment as in I-F and R-F alignment procedures in section 7, paragraph 4.j.

TABLE 7-1. RECEIVER FAILURE CHART, CONT.

SYMPTOM	PROBABLE CAUSE	CORRECTION
No reception on the following bands:		
1	Hfo not operating	Replace 4 mc crystal, Y110.
4	Hfo not operating	Replace 6 mc crystal, Y109.
5, 6, 13, 14	Hfo not operating	Replace 8 mc crystal, Y108.
7, 8, 17, 18, 27, 28	Hfo not operating	Replace 10 mc Xtal, Y107.
9, 10, 21, 22	Hfo not operating	Replace 12 mc Xtal, Y106.
11, 12, 25, 26	Hfo not operating	Replace 14 mc Xtal, Y105.
15, 16	Hfo not operating	Replace 9 mc Xtal, Y104.
19, 20	Hfo not operating	Replace 11 mc Xtal, Y103.
23, 24	Hfo not operating	Replace 13 mc Xtal, Y102.
29, 30	Hfo not operating	Replace 10.67 mc Xtal, Y101.
Weak reception:		
Band 1 only	Band 1 r-f alignment out.	See section 7, paragraph 4.j.(2).(f).
Bands 2-3 only	R-f alignments out.	See section 7, paragraph 4.j.(2).(a),(b).
Bands 4-7 only	R-f alignments out.	See section 7, paragraph 4.j.(2).(c)
Bands 8-15 only	R-f alignments out.	See section 7, paragraph 4.j.(2).(d).
Bands 16-30 only	R-f alignments out.	See section 7, paragraph 4.j.(2).(e).
Distorted audio with limiter in or out.	Faulty detector	Check tube V110, C202, R151, R150.
Distorted audio with limiter in only.	Clipping in noise limiter taking place at too low a value of modulation.	Check time constant consisting of R152 and C205C in circuit of V112. Make overall voltage and resistance checks in this stage.
Weak output with AVC ON.	Avc amplifier threshold bias too high.	Check R164, R165, R166, and R146. Make complete voltage and resistance checks on pins 1, 2, and 3 of V110 and V111.

TABLE 7-1. RECEIVER FAILURE CHART, CONT.

SYMPTOM	PROBABLE CAUSE	CORRECTION
Input to 2nd mixer V106 is O.K. No audio output.	Vfo not operating to give 500-kc i-f output.	Check plate voltages on tubes V001 and V002. If no plate voltage--check voltage regulator tube V116. Make complete voltage and resistance checks in the vfo stages.
No audio beat observed with BFO ON.	Bfo inoperative	Check tube V114. Make voltage and resistance checks in the stage.
CALIBRATE ON - No 100-kc checkpoints observed.	Faulty 100-kc oscillator stage.	Check tube V104. Check 100-kc Xtal, Y111. Make voltage and resistance checks in this stage.

3. VOLTAGE AND RESISTANCE MEASUREMENTS.

Figure 7-1 gives typical voltage and resistance measurements with respect to ground taken at electron tube terminals. Conditions for measurements are given with the table and must be duplicated to make valid comparisons.

In making resistance checks, bear in mind that the resistance measured may be the series, parallel, or series-parallel combinations of several components. Should a measured value show a considerable discrepancy from the value tabulated, make a further check of the components included in the measurement. When necessary, unsolder terminals to investigate parallel combinations thoroughly. In considering discrepancies, take into account the allowances for manufacturing tolerances on resistor ratings.

WARNING

VOLTAGES UP TO 300 VOLTS WILL BE ENCOUNTERED WHEN MAKING THE FOLLOWING MEASUREMENTS. EXERCISE CARE WHEN PLACING LEADS ON THE MINIATURE TUBE TERMINALS. IF TERMINALS ARE CONGESTED, PREVENT SHORTS AND POSSIBLE DAMAGE TO CIRCUIT COMPONENTS BY TURNING OFF POWER BEFORE AFFIXING VOLTMETER LEAD.

4. ELECTRICAL ADJUSTMENTS.

a. CRYSTAL OSCILLATOR TRIMMER ADJUSTMENT.

(1) TEST EQUIPMENT NEEDED FOR ALIGNMENT.

(a) "Q" meter or accurate capacitance measuring bridge.

(b) 470K-ohm resistor.

(c) Electronic voltmeter. (Multimeter ME-25/U Series or equivalent.

(2) PROCEDURE.

(a) Remove any one of the hfo crystals and set the BAND SWITCH to the related band. (See paragraph 8, this section.) With capacitance measuring device, adjust trimmer C167 (marked XTAL on the chassis) to provide an input capacitance of 32 mmf across the crystal holder. This value will occur at or near minimum capacitance setting. If this capacitor is badly mistuned, the crystals will be off frequency and low in output.

(b) Connect 470K-ohm resistor to pin 7 of tube V102. Connect a d-c electronic voltmeter between free end of resistor and the chassis. This resistor reduces the effect of the capacitance of the meter lead.

In all of the following adjustments, peak the trimmers if the indicated voltage is not more than 2 volts. If it is more than 2 volts, detune the trimmer toward minimum capacitance, until voltage reads 2. See figure 7-2 for location of trimmer adjustments.

1. Turn receiver on. Set bandswitch on band 30; then tune trimmer marked 30 according to the above procedure.

2. Repeat, tuning trimmer marked 28, with bandswitch on band 28.

3. Repeat on even bands from 26 through 14, tuning correspondingly marked trimmers.

4. Repeat with bandswitch on band 1. Adjust trimmer labeled B. C. that is nearer V105.

(c) Remove 470K-ohm resistor from V102. Connect the resistor to pin 1 of V103. Connect VTVM between free end of resistor and chassis.

1. Place bandswitch on band 1. Tune for maximum indication on the voltmeter the trimmer marked B. C. that was not previously tuned.

b. 100-KC CALIBRATION OSCILLATOR ALIGNMENT.

(1) TEST EQUIPMENT NEEDED.

(a) Accurate frequency standard or WWV carrier reception.

(2) PROCEDURE.

(a) See SECTION 4--paragraph 3-c.

c. FIXED 500 KC I-F AMPLIFIER ALIGNMENT.

(1) TEST EQUIPMENT NEEDED.

(a) Signal generator (R. F. Signal Generator Set AN/URM-25 Series or equivalent).

(b) Electronic voltmeter (Multimeter ME-25/U Series or equivalent).

(c) Detuning network consisting of 0.01-mf capacitor in series with a 4700-ohm resistor.

NOTE

THE CALIBRATION OSCILLATOR MAY BE USED IF A SIGNAL GENERATOR IS NOT AVAILABLE. USE THE PROCEDURE OUTLINED BUT LEAVE THE CALIBRATION OSCILLATOR ON. SET THE BFO AT EXACTLY 500 KC AS OUTLINED IN THIS SECTION, PARAGRAPH 4.e. COUPLE THE OUTPUT OF THE CALIBRATION OSCILLATOR, C173, TO PIN 7 OF V106 WITH A CLIP LEAD. TUNE THE RECEIVER TO EACH ALIGNMENT FREQUENCY BY ZERO BEATING WITH BFO. (TUNING MAY ALSO BE ACCOMPLISHED BY PEAKING THE INPUT METER INSTEAD OF ZERO BEATING WITH BFO.

(2) PROCEDURE.

(a) Connect signal generator between pin 7 of V106 and chassis. Set the signal generator output at exactly 500-kc as follows. Connect one end of a clip lead to output of 100-kc calibration oscillator at C173. Hold other end near the grid of V106. Turn BFO on. Set signal generator to zero beat at 500 kc with the 100-kc oscillator. Turn off the 100-kc calibration oscillator and remove clip lead. Connect detuning network from the plate of V107 to chassis. Connect VTVM from diode load resistor R151 to chassis. Place SELECTIVITY switch, S114, in "0" position. Refer to figures 7-2 and 7-11 through 7-14 for location of adjustments.

1. Tune secondary of T103 by adjusting the bottom slug for maximum indication of the VTVM. Keep diode load voltage below 3 volts by adjusting the signal generator output.

2. Connect detuning network from terminal 4 of T103 to chassis. Tune top slug (primary) for maximum indication on the VTVM.

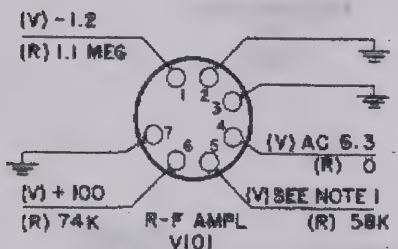
3. Connect detuning network from plate of V108 to chassis. Tune secondary of T104 for maximum indication on the VTVM.

4. Connect detuning network to terminal 4 of T104. Tune primary of T104 for maximum indication on VTVM.

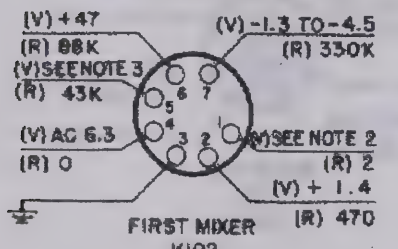
5. Connect detuning network to plate of V109. Tune secondary of T105 for maximum indication on VTVM.

NOTES :

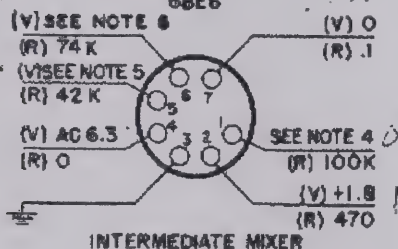
ALL MEASUREMENTS TAKEN FROM SOCKET
TAKEN WITH NO AC INPUT, BUT POWER SWITC
GAIN CONTROLS ARE ON FULL. AVC IS ON.
ALL OTHER SWITCHES ARE OFF UNLESS OT
VOLTAGE MEASUREMENTS TAKEN WITH 115V
RF GAIN FULL ON, AUDIO GAIN OFF, AVC ON
ALL OTHER SWITCHES ARE OFF UNLESS OT
VOLTAGES MEASURED WITH ELECTRONIC VOL
ALL VOLTAGES EXCEPT HEATERS ARE D.C.
NC MEANS NO CONNECTION.



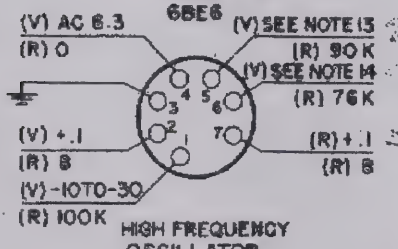
R-F AMPL
V101
6AK5



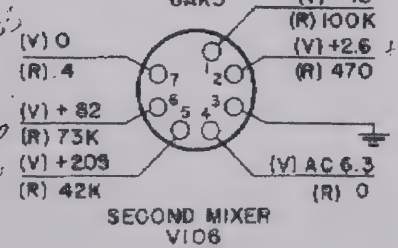
FIRST MIXER
V102
6BE6



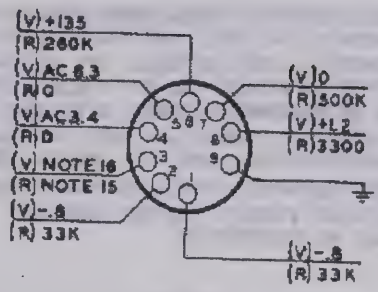
INTERMEDIATE MIXER
V103
6BE6



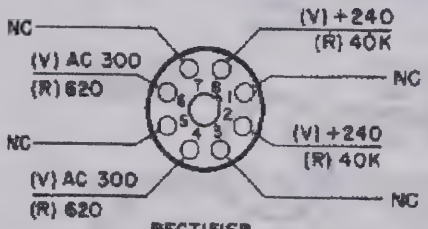
HIGH FREQUENCY
OSCILLATOR
V105
6AK5



SECOND MIXER
V106
6BE6



LIMITER
AND AUDIO AMPL
V112
12AX7



RECTIFIER
V115
5V4G

(b) Connect 470K-ohm resistor to pin 7 of tube V102. Connect a d-c electronic voltmeter between free end of resistor and the chassis. This resistor reduces the effect of the capacitance of the meter lead.

In all of the following adjustments, peak the trimmers if the indicated voltage is not more than 2 volts. If it is more than 2 volts, detune the trimmer toward minimum capacitance, until voltage reads 2. See figure 7-2 for location of trimmer adjustments.

1. Turn receiver on. Set bandswitch on band 30; then tune trimmer marked 30 according to the above procedure.

2. Repeat, tuning trimmer marked 28, with bandswitch on band 28.

3. Repeat on even bands from 26 through 14, tuning correspondingly marked trimmers.

4. Repeat with bandswitch on band 1. Adjust trimmer labeled B. C. that is nearer V105.

(c) Remove 470K-ohm resistor from V102. Connect the resistor to pin 1 of V103. Connect VTVM between free end of resistor and chassis.

1. Place bandswitch on band 1. Tune for maximum indication on the voltmeter the trimmer marked B. C. that was not previously tuned.

b. 100-KC CALIBRATION OSCILLATOR ALIGNMENT.

(1) TEST EQUIPMENT NEEDED.

(a) Accurate frequency standard or WWV carrier reception.

(2) PROCEDURE.

(a) See SECTION 4--paragraph 3-c.

c. FIXED 500 KC I-F AMPLIFIER ALIGNMENT.

(1) TEST EQUIPMENT NEEDED.

(a) Signal generator (R. F. Signal Generator Set AN/URM-25 Series or equivalent).

(b) Electronic voltmeter (Multimeter ME-25/U Series or equivalent).

(c) Detuning network consisting of 0.01-mf capacitor in series with a 4700-ohm resistor.

NOTE

THE CALIBRATION OSCILLATOR MAY BE USED IF A SIGNAL GENERATOR IS NOT AVAILABLE. USE THE PROCEDURE OUTLINED BUT LEAVE THE CALIBRATION OSCILLATOR ON. SET THE BFO AT EXACTLY 500 KC AS OUTLINED IN THIS SECTION, PARAGRAPH 4.e. COUPLE THE OUTPUT OF THE CALIBRATION OSCILLATOR, C173, TO PIN 7 OF V106 WITH A CLIP LEAD. TUNE THE RECEIVER TO EACH ALIGNMENT FREQUENCY BY ZERO BEATING WITH BFO. (TUNING MAY ALSO BE ACCOMPLISHED BY PEAKING THE INPUT METER INSTEAD OF ZERO BEATING WITH BFO.

(2) PROCEDURE.

(a) Connect signal generator between pin 7 of V106 and chassis. Set the signal generator output at exactly 500-kc as follows. Connect one end of a clip lead to output of 100-kc calibration oscillator at C173. Hold other end near the grid of V106. Turn BFO on. Set signal generator to zero beat at 500 kc with the 100-kc oscillator. Turn off the 100-kc calibration oscillator and remove clip lead. Connect detuning network from the plate of V107 to chassis. Connect VTVM from diode load resistor R151 to chassis. Place SELECTIVITY switch, S114, in "0" position. Refer to figures 7-2 and 7-11 through 7-14 for location of adjustments.

1. Tune secondary of T103 by adjusting the bottom slug for maximum indication of the VTVM. Keep diode load voltage below 3 volts by adjusting the signal generator output.

2. Connect detuning network from terminal 4 of T103 to chassis. Tune top slug (primary) for maximum indication on the VTVM.

3. Connect detuning network from plate of V108 to chassis. Tune secondary of T104 for maximum indication on the VTVM.

4. Connect detuning network to terminal 4 of T104. Tune primary of T104 for maximum indication on VTVM.

5. Connect detuning network to plate of V109. Tune secondary of T105 for maximum indication on VTVM.

NOTES:

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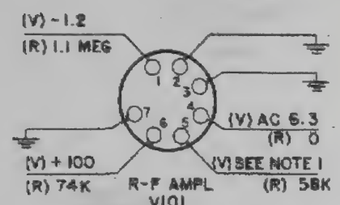
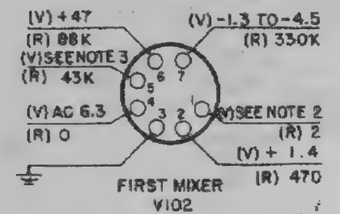
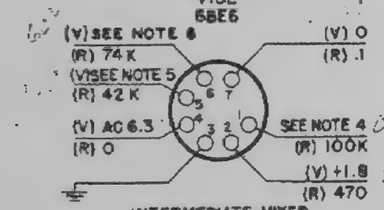
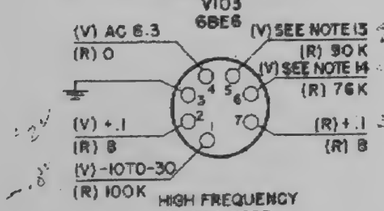
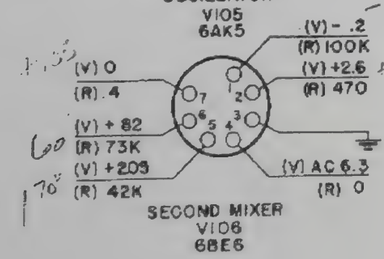
GAIN CONTROLS ARE ON FULL. AVC IS ON.
ALL OTHER SWITCHES ARE OFF UNLESS OTHERWISE NOTED.
VOLTAGE MEASUREMENTS TAKEN WITH 115V AC INPUT, POWER SWITCH ON, BUT NO INPUT SIGNAL.
RF GAIN FULL ON, AUDIO GAIN OFF, AVC ON.
ALL OTHER SWITCHES ARE OFF UNLESS OTHERWISE NOTED.
VOLTAGES MEASURED WITH ELECTRONIC VOLTMETER, 11 MEGOHMS INPUT RESISTANCE.
ALL VOLTAGES EXCEPT HEATERS ARE D.C.
NC MEANS NO CONNECTION.

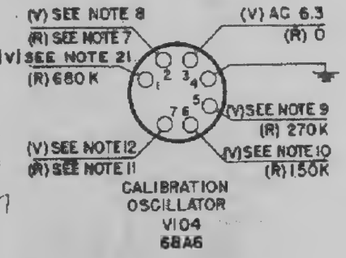


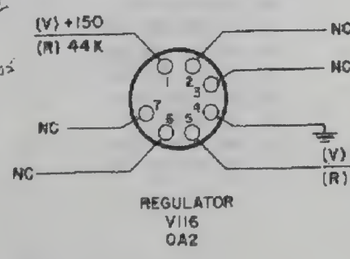


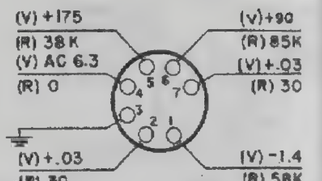


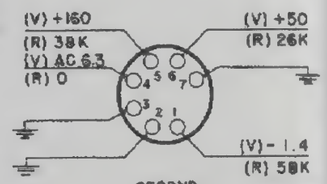


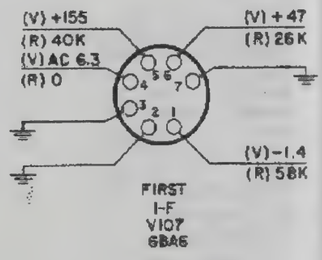


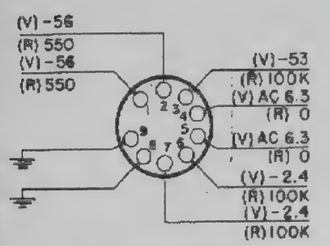


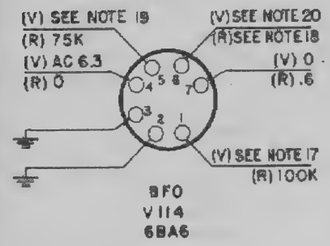


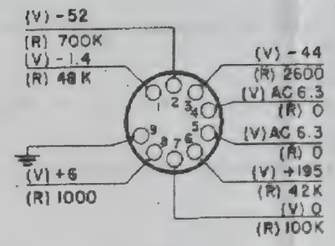


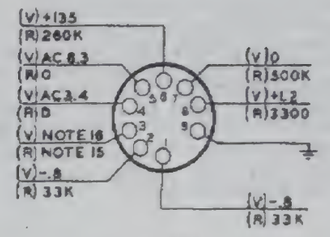


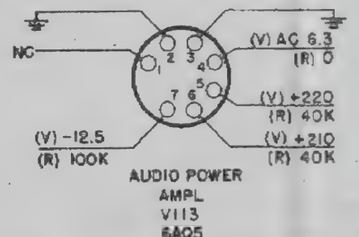


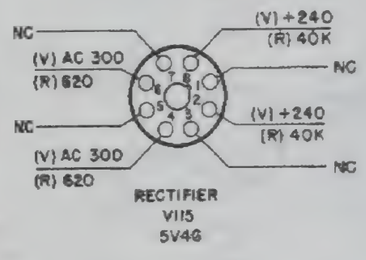












NOTES:

1. BAND 1 (V) +58
   BANDS 2 TO 3 (V) +190
   BANDS 4 TO 30 (V) +125
2. (V) 0 SMALL INDICATION ON BANDS 2 AND 3.
3. BAND 1 (V) +180
   BANDS 2 TO 3 SMALL IND.
   BANDS 4 TO 30 (V) +210
4. BAND 1 (V) -1.3
   BAND 2 (V) -2.0
   BANDS 3 TO 30 (V) 0
5. BAND 1 (V) +210
   BANDS 2 TO 30 (V) 0
6. BAND 1 (V) +85
   BANDS 2 TO 30 (V) +70
7. (R) 0 CAL. OFF
   (R) 4700 CAL. ON
8. (V) +60 CAL. OFF
   (V) +7.2 CAL. ON
9. (V) +170 CAL. OFF
   (V) +80 CAL. ON
10. (V) +175 CAL. OFF
    (V) +64 CAL. ON
11. (R) ∞ CAL. OFF
    (R) 4700 CAL. ON
12. (V) +60 CAL. OFF
    (V) +7.2 CAL. ON
13. BANDS 1 TO 2 (V) +39
    BANDS 3 TO 12 (V) +165
    BANDS 13 TO 30 (V) +39
14. BANDS 1 TO 2 (V) +105
    BANDS 3 TO 12 (V) +115
    BANDS 13 TO 30 (V) +105
15. (R) 33K LIM. OUT
    (R) 1 MEG. LIM. IN
16. (V) -.8 LIM. OUT
    (V) -.3 LIM. IN
17. (V) -.5 BFO OFF
    (V) -10 BFO ON
18. (R) 0 BFO OFF
    (R) 142K BFO ON
19. (V) 200 BFO OFF
    (V) 140 BFO ON
20. (V) 0 BFO OFF
    (V) 69 BFO ON
21. (V) 0 CAL. OFF
    (V) -24 CAL. ON

Figure 7-1. Receiver Voltage and Resistance Chart

NOTES:

ALL MEASUREMENTS TAKEN FROM SOCKET PINS TO GROUND, RESISTANCE MEASUREMENTS TAKEN WITH NO AC INPUT, BUT POWER SWITCH ON.
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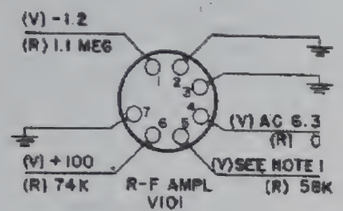
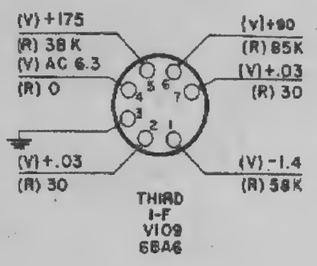
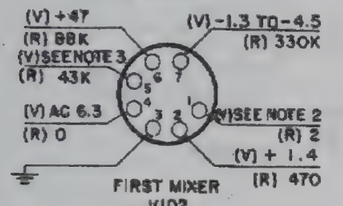
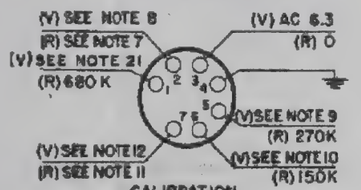
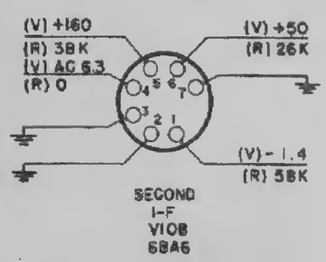










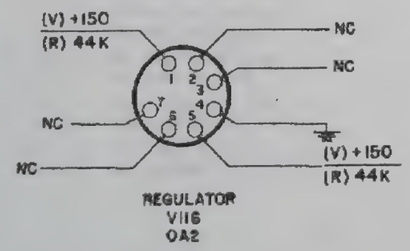
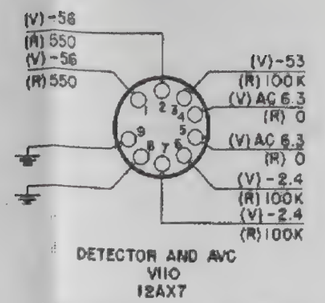
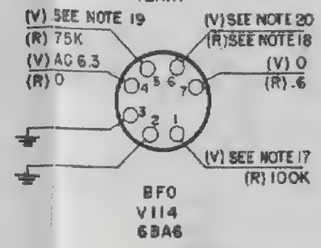
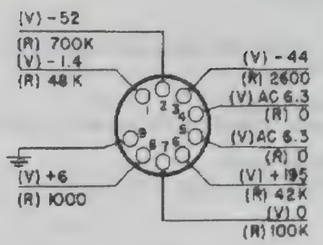
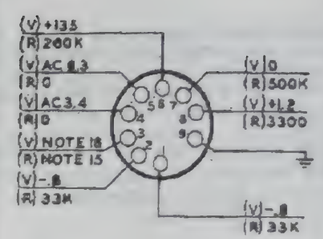


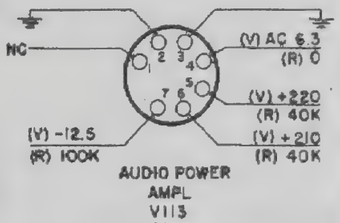
Figure 7-1. Receiver Voltage and Resistance Chart

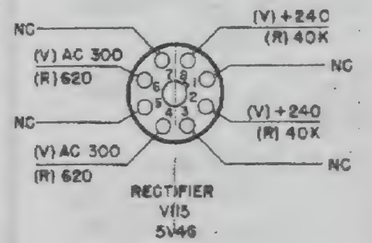












NOTES:

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   BANDS 2 TO 3 (V) +190
   BANDS 4 TO 30 (V) +125
2. (V) 0 SMALL INDICATION ON BANDS 2 AND 3.
3. BAND 1 (V) +180
   BANDS 2 TO 3 SMALL IND.
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5. BAND 1 (V) +210
   BANDS 2 TO 30 (V) 0
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   BANDS 2 TO 30 (V) +70
7. (R) 0 CAL. OFF
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8. (V) +60 CAL. OFF
   (V) +7.2 CAL. ON
9. (V) +170 CAL. OFF
   (V) +80 CAL. ON
10. (V) +175 CAL. OFF
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14. BANDS 1 TO 2 (V) +105
    BANDS 3 TO 12 (V) +115
    BANDS 13 TO 30 (V) +105
15. (R) 33K LIM. OUT
    (R) 1 MEG. LIM. IN
16. (V) -.8 LIM. OUT
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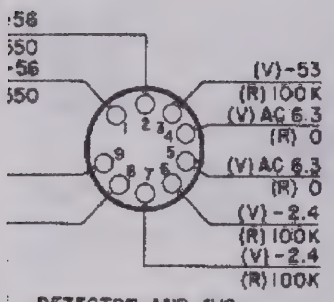
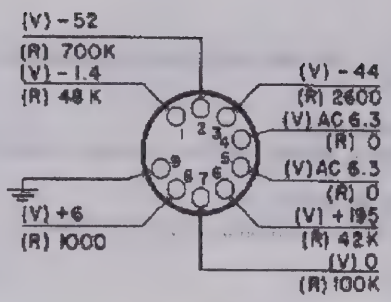
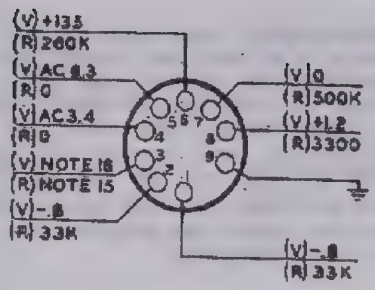
    (V) -10 BFO ON
18. (R) 0 BFO OFF
    (R) 142K BFO ON
19. (V) 200 BFO OFF
    (V) 140 BFO ON
20. (V) 0 BFO OFF
    (V) 69 BFO ON
21. (V) 0 CAL. OFF
    (V) -24 CAL. ON



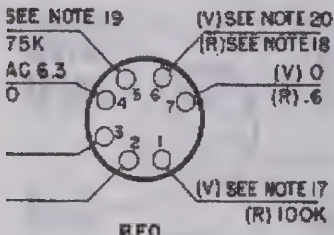
DETECTOR AND AVC
V110
12AX7



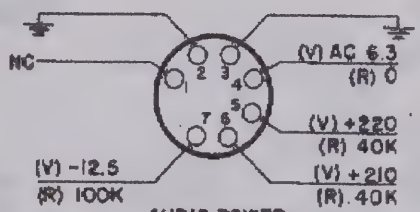
AVC AMPL
AND FOLLOWER
V111
12AU7



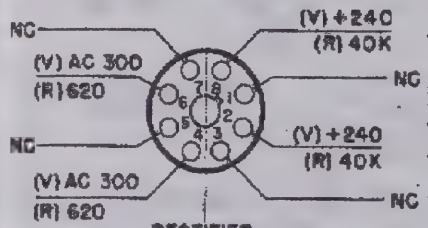
LIMITER
AND AUDIO AMPL
V112
12AX7



BFO
V114
6BA6



AUDIO POWER
AMPL
V113
6AQ5



RECTIFIER
V115
5V4G

NOTES:

1. BAND 1 (V) +58
   BANDS 2 TO 3 (V) +190
   BANDS 4 TO 30 (V) +125
2. (V) 0 SMALL INDICATION ON BANDS 2 AND 3.
3. BAND 1 (V) +180
   BANDS 2 TO 3 SMALL IND.
   BANDS 4 TO 30 (V) +210
4. BAND 1 (V) -1.3
   BAND 2 (V) -2.0
   BANDS 3 TO 30 (V) 0
5. BAND 1 (V) +210
   BANDS 2 TO 30 (V) 0
6. BAND 1 (V) +85
   BANDS 2 TO 30 (V) +70
7. (R) 0 CAL. OFF
   (R) 4700 CAL. ON
8. (V) +60 CAL. OFF
   (V) +7.2 CAL. ON
9. (V) +170 CAL. OFF
   (V) +80 CAL. ON
10. (V) +175 CAL. OFF
    (V) +64 CAL. ON
11. (R) ∞ CAL. OFF
    (R) 4700 CAL. ON
12. (V) +60 CAL. OFF
    (V) +7.2 CAL. ON
13. BANDS 1 TO 2 (V) +39
    BANDS 3 TO 12 (V) +165
    BANDS 13 TO 30 (V) +39
14. BANDS 1 TO 2 (V) +105
    BANDS 3 TO 12 (V) +115
    BANDS 13 TO 30 (V) +105
15. (R) 33K LIM. OUT
    (R) 1 MEG. LIM. IN
16. (V) -.8 LIM. OUT
    (V) -.3 LIM. IN
17. (V) -.5 BFO OFF
    (V) -10 BFO ON
18. (R) 0 BFO OFF
    (R) 142K BFO ON
19. (V) 200 BFO OFF
    (V) 140 BFO ON
20. (V) 0 BFO OFF
    (V) 69 BFO ON
21. (V) 0 CAL. OFF
    (V) -24 CAL. ON

5

LS

COILS

- .5 TO 1.5 MC

- 1.5 TO 2.5 MC

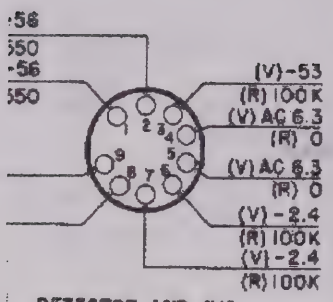
- 2.5 TO 3.5 MC

PLATE - .5 TO 1.5 MC
ITING TOWARD
MAX. C

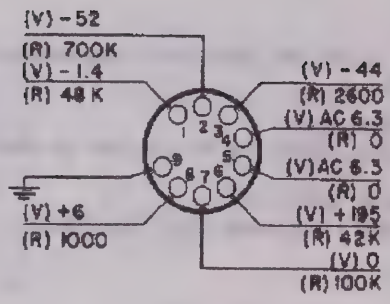
TO 11.5 IF

TO 2.5 IF

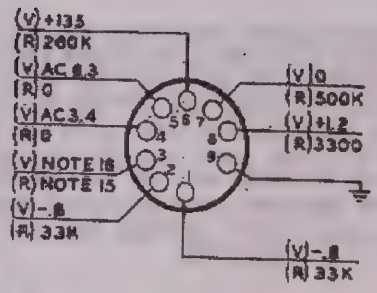
TO 2.5 IF



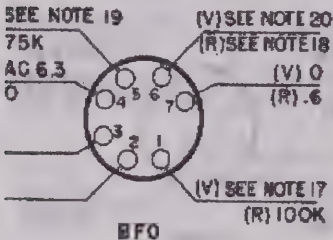
DETECTOR AND AVC
V110
12AX7



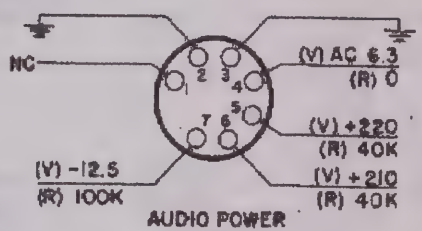
AVC AMPL
AND FOLLOWER
V111
12AU7



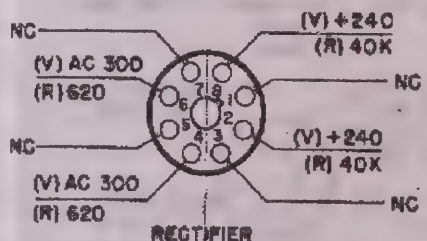
LIMITER
AND AUDIO AMPL
V112
12AX7



BFO
V114
6BA6



AUDIO POWER
AMPL
V113
6AQ5



RECTIFIER
V115
5V4G

NOTES:

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3. BAND 1 (V) +180
   BANDS 2 TO 3 SMALL IND.
   BANDS 4 TO 30 (V) +210
4. BAND 1 (V) -1.3
   BAND 2 (V) -2.0
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5. BAND 1 (V) +210
   BANDS 2 TO 30 (V) 0
6. BAND 1 (V) +85
   BANDS 2 TO 30 (V) +70
7. (R) 0 CAL. OFF
   (R) 4700 CAL. ON
8. (V) +60 CAL. OFF
   (V) +72 CAL. ON
9. (V) +170 CAL. OFF
   (V) +80 CAL. ON
10. (V) +175 CAL. OFF
    (V) +64 CAL. ON
11. (R) ∞ CAL. OFF
    (R) 4700 CAL. ON
12. (V) +60 CAL. OFF
    (V) +7.2 CAL. ON
13. BANDS 1 TO 2 (V) +39
    BANDS 3 TO 12 (V) +165
    BANDS 13 TO 30 (V) +39
14. BANDS 1 TO 2 (V) +105
    BANDS 3 TO 12 (V) +115
    BANDS 13 TO 30 (V) +105
15. (R) 33K LIM. OUT
    (R) 1 MEG. LIM. IN
16. (V) -.8 LIM. OUT
    (V) -.3 LIM. IN
17. (V) -.5 BFO OFF
    (V) -10 BFO ON
18. (R) 0 BFO OFF
    (R) 142K BFO ON
19. (V) 200 BFO OFF
    (V) 140 BFO ON
20. (V) 0 BFO OFF
    (V) 69 BFO ON
21. (V) 0 CAL. OFF
    (V) -24 CAL. ON

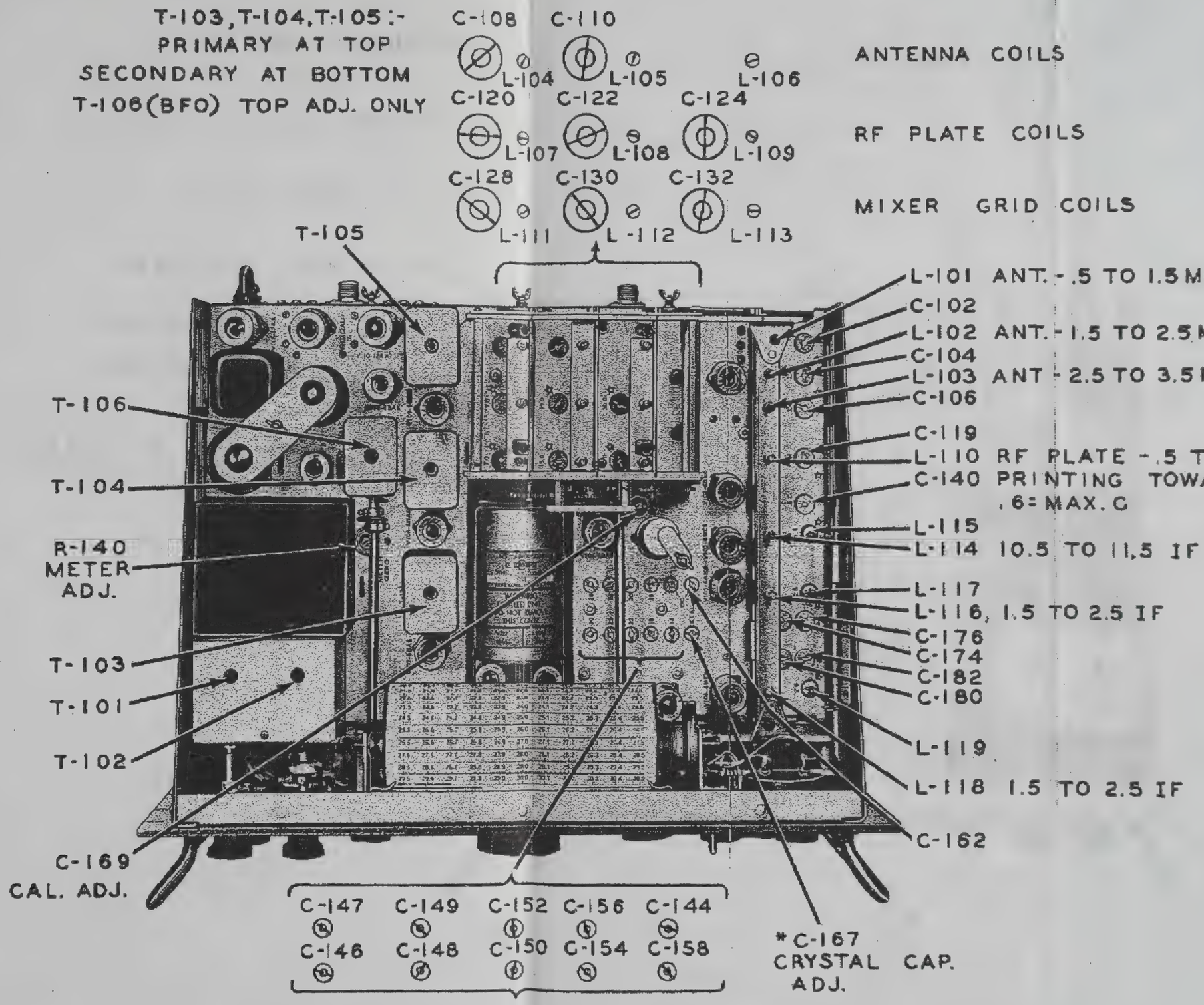


Figure 7-2. Alignment Adjustments

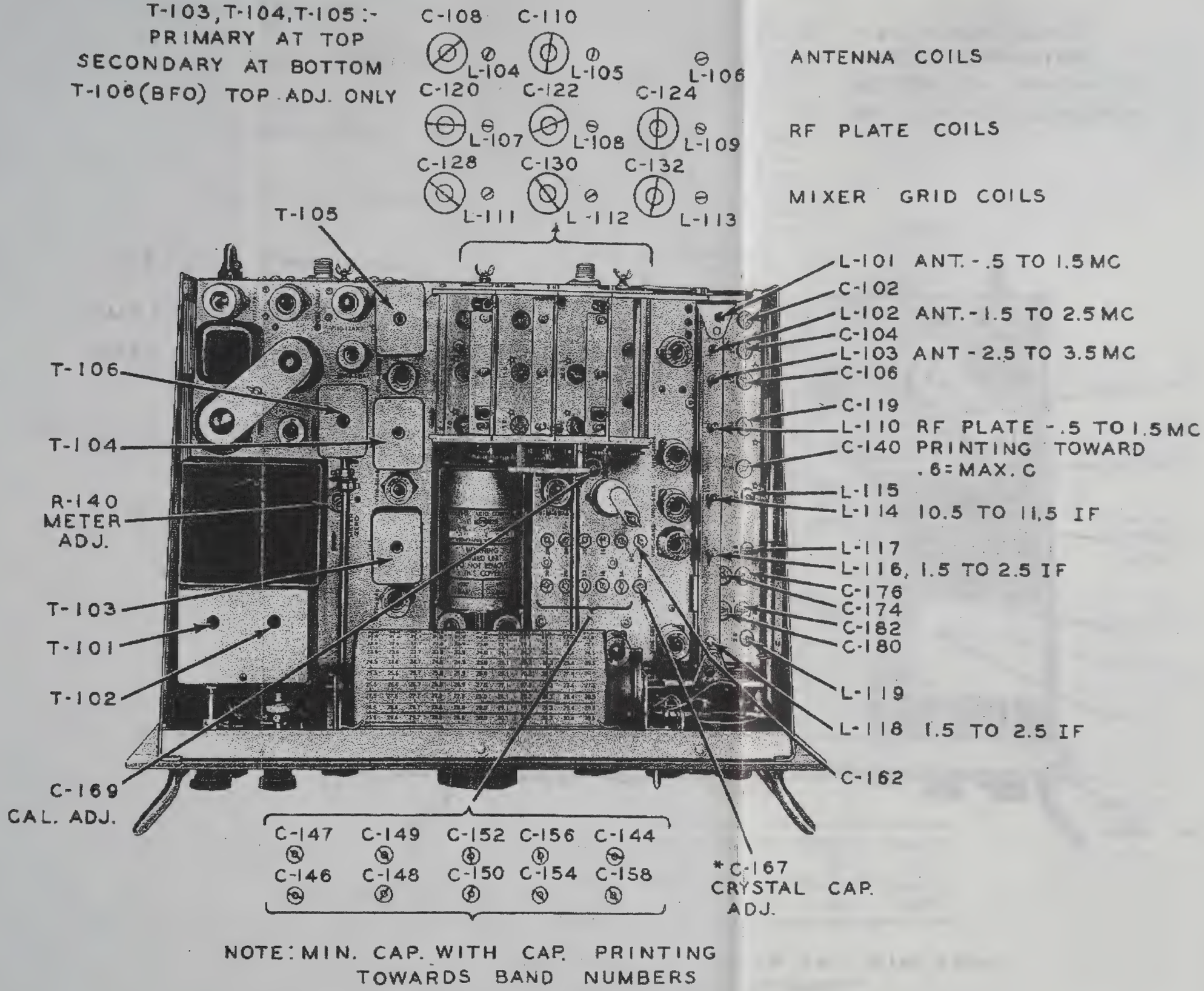


Figure 7-2. Alignment Adjustments

ANTENNA COILS

RF PLATE COILS

MIXER GRID COILS

L-101 ANT. - .5 TO 1.5 MC
C-102
L-102 ANT. - 1.5 TO 2.5 MC
C-104
L-103 ANT - 2.5 TO 3.5 MC
C-106

C-119
L-110 RF PLATE - .5 TO 1.5 MC
C-140 PRINTING TOWARD
.6 = MAX. C

L-115
L-114 10.5 TO 11.5 IF

L-117
L-116, 1.5 TO 2.5 IF
C-176
C-174
C-182
C-180

L-119

L-118 1.5 TO 2.5 IF

C-162

-167
YSTAL CAP.
DJ.

6. Connect detuning network to terminal 4 of T105. Tune primary of T105 for maximum indication of VTVM.

7. Remove detuning network from terminal 4 of T105. Tune T101 for maximum indication on VTVM.

d. BFO ALIGNMENT.

(1) TEST EQUIPMENT NEEDED.

(a) Signal generator (R.F. Signal Generator Set AN/URM-25 Series or Equivalent).

(2) PROCEDURE.

(a) Set signal generator at exactly 500 kc by zero beating with the 100-kc calibration oscillator as in this section, paragraph 4.c.(2)(a), above.

1. If the BFO PITCH knob has never been off the shaft, align the bfo as follows: Turn BFO on. Set the line on the BFO PITCH knob at the fiducial mark on the panel. Adjust core in top to T106 (figure 7-2) to zero beat. BFO PITCH is now set at 500 kc.

2. If the BFO PITCH knob has been removed from the shaft, align the bfo as follows: Turn BFO on. Adjust core in top of T106 to produce a beat note. Line up the BFO PITCH knob with the panel mark and with the mid-range point of the bfo pitch capacitor by turning the BFO PITCH knob to either the right or the left of the fiducial panel mark until the pitch of the beat note rises to a maximum. Leave BFO PITCH knob exactly at point of maximum pitch. BFO PITCH capacitor plates are now either all in or all out. Loosen set screws in BFO PITCH knob and rotate knob on shaft until knob mark is 90 degrees from the panel mark. Tighten set screws. Set knob mark at the fiducial mark on the panel. BFO PITCH capacitor is now at mid-range. Adjust core in top of T106 to zero beat. Bfo is now set at 500 kc.

e. ALTERNATE BFO ALIGNMENT--WITHOUT SIGNAL GENERATOR.

(1) TEST EQUIPMENT NEEDED.

(a) Uses no special equipment.

(2) PROCEDURE.

(a) Disconnect antenna from terminal at rear of chassis. Turn 100-kc calibration oscillator on.

(b) Tune receiver to a 100-kc check point on bands 2 or 3. For example, tune receiver to 2.0 mc.

(c) Line up the BFO PITCH knob with the panel mark and with the mid-range of BFO PITCH capacitor as follows:

1. If the BFO PITCH knob has never been off the shaft, turn the knob until the knob mark lines up with the panel mark on the receiver. Then proceed as in steps 3 and 4 below.

2. If the BFO PITCH knob has been removed from the shaft, adjust the core in T106 to produce a beat note. Turn BFO PITCH knob either to the right or to the left of the panel mark until the beat note's pitch rises to a maximum. Leave knob exactly at point of maximum pitch. BFO PITCH capacitor plates are now either all in or all out. Loosen set screws in BFO PITCH knob and rotate knob on shaft until knob mark is 90 degrees from panel mark. Tighten set screws. Turn knob to mark on panel. BFO PITCH is now at mid-range.

3. After performing either step 1 or step 2, above, tune the receiver at least 10 kc off any 0.1 megacycle point on bands 2 or 3, and turn up AUDIO GAIN until a constant pitch beat note is audible. If the constant pitch beat note is not audible, adjust tuning core in top of T106 until it is. Make certain that this is the correct note by turning the KILOCYCLE dial ±10 kc and noting whether the pitch of the beat note remains constant.

This constant pitch beat note, which occurs only on bands 2 and 3, is produced by a small amount of fifth harmonic from the 100-kc calibration oscillator that leaks into the i-f strip through the second mixer stage and beats with the signal from the bfo. Because of the superior strength of the calibration beat note in the vicinity of a 100-kc check point, this constant pitch beat note is most audible about half-way between check points.

4. Adjust tuning core of T106 for zero beat. The bfo frequency is now 500 kc when the BFO PITCH knob is set at the fiducial mark on the panel.

f. CRYSTAL PHASING ADJUSTMENT (T-102 ALIGNMENT)

(1) TEST EQUIPMENT NEEDED.

(a) Oscilloscope OS-8/U Series or equivalent.

(b) Frequency-modulated signal generator.

(c) Fiber or bakelite adjusting tool (Supplied).

(2) PROCEDURE.

(a) Line up the crystal filter PHASING control knob with the panel mark and with the mid-range position of the phasing capacitor. To accomplish this, use a flashlight and look into the right-hand hole in the top of the crystal filter cover in order to see the plates of the phasing capacitor (See figure 5-1). Turn the PHASING control until the rotor plates are straight down toward the bottom of the receiver, i. e., until the rotor plates completely engage the bottom set of stator plates. Loosen set screws in PHASING control knob. Set knob line 90 degrees to the left of the panel mark. Tighten set screws. Turn knob to panel mark. Phasing capacitor is now at mid-range.

(b) Connect the frequency-modulated signal generator to pin 7 of V106. The carrier frequency of the generator should be between 1.5 and 3.5 mc. The frequency excursion of the carrier should be about 20 kc. The rate of excursion should be as rapid as possible without blocking the signal in the crystal filter. The rate will be low due to the inertia of the 500-kc filter crystal.

Connect the vertical plate input of the oscilloscope to the junction of R150 and R151 (detector load resistors).

(c) Turn SELECTIVITY switch to position 1. Turn AVC off, LIMITER off, BFO off, CALIBRATE off, and AUDIO GAIN to position 0.

(d) Tune receiver to the carrier frequency of the signal generator, which should be in the range between 1.5 and 3.5 mc.

(e) Turn RF GAIN to position 5, and synchronize scope. Two fairly symmetrical peaks should appear on the scope screen. If they do not, adjust receiver tuning, RF GAIN, and oscilloscope controls until they do. Each of these two peaks is essentially an i-f response curve. Two peaks appear for one complete frequency excursion of the generator carrier because the excursion sweeps through and returns through a given number of cps. Therefore a double indication of response is shown on the oscilloscope, one being the image of the other. Either peak can be used to make the following adjustment.

(f) Rotation of the PHASING control of the left should cause rejection notch to appear at one side of each peak. If this notch does not appear, set the PHASING control about one-eighth turn to the left of center and adjust the core in the top of T102 (accessible through the right-hand hole in the crystal filter cover (figure 7-2) until it does appear and is well-defined on the scope screen. Adjust until no evidence of damped oscillations appears on the notch.

(g) Turn PHASING control about one-eighth turn to the right of center. Check to see that the rejection notch appears on the opposite side of the peaks, and without further adjustment, is well defined and without evidence of damped oscillations. If this is not the case, adjust core in T102 slightly.

(h) Repeat steps (f) and (g) until the notch obtained is symmetrical and well defined as it is moved through the range.

(i) ALTERNATE METHOD -- In the event that a frequency modulated signal generator is not available, T-102 may be aligned using an AM signal generator and d-c electronic voltmeter as follows:

1. Perform step (2)(a) above.

2. Apply a 1.5 to 3.5-mc signal from signal generator to pin 7 of V106. Connect d-c voltmeter to the junction of R150 and R151.

3. With the SELECTIVITY control in position 4, carefully tune the receiver to the signal generator frequency and adjust the fiducial line on the KILOCYCLE dial so that it is placed directly over a scale mark (to be used as reference line).

4. Place SELECTIVITY control in position 1 and back the KILOCYCLE dial off 3-kc from the reference point. At this dial setting, adjust the core in T102 for a peak reading on the voltmeter.

5. Set KILOCYCLE dial 3-kc off reference in the opposite direct on to that above and again adjust T102 for a peak reading on the voltmeter. Carefully note the direction and magnitude of this second adjustment and set the T102 adjustment midway. T102 is now approximately aligned for correct crystal phasing.

g. 500-KC I-F PERFORMANCE MEASUREMENTS.

(1) TEST EQUIPMENT NEEDED.

(a) R-F Signal Generator Set AN/URM-25 Series or equivalent.

(b) Electronic voltmeter (Multimeter ME-25/U Series or equivalent.

(2) PROCEDURE.

(a) SENSITIVITY. - With AVC turned off, apply a 500-kc signal from the signal generator between pin 7 of V106 and chassis. (Calibration of the signal generator should be checked as in this section, paragraph 4.c.(2) (a).) Connect VTVM from diode load resistor R151 to chassis.

The input to pin 7 of V106 at 500 kc should be within the range of 25 to 40 uv for a 4-volt reading at the diode load. If not, re-check alignment and circuits in the i-f stages and check tubes involved to locate fault.

(b) SELECTIVITY. -

1. Adjust the output level of the signal generator for 4 volts at the diode load. Note the signal generator output reading at this setting. This voltage and the 4-volt diode load reading are the reference voltages.

2. Increase the output level of the signal generator to twice the previously noted voltage (6 db increase). Detune signal generator on either side of the initial 500-kc setting until the diode load voltage drops back to the 4-volt reference. The resulting change in input frequency is the measure of selectivity at 6 db down.

3. Re-set the signal generator frequency to the 500-kc reference and adjust the output level for the 4-volt diode load reading as in step 1. Increase the output level of the signal generator 1000 times (60 db increase), and proceed as in step 2 to determine the selectivity at 60 db down.

4. OVERALL SELECTIVITY SPECIFICATIONS.

Minimum selectivity (crystal filter out)

6 db	5.5 kc min.	6.5 kc max.
60 db	17.0 kc min.	20.0 kc max.

Maximum selectivity (crystal filter in)

6 db	0.2 kc min.	0.3 kc max.
60 db	0.2 kc min.	12.0 kc max.

5. Typical Curves for positions 0, 1, and 4 of the SELECTIVITY control are shown in figure 7-3.

h. ALIGNMENT OF DIALS WITH VFO.

(1) TEST EQUIPMENT NEEDED.

(a) No special equipment needed.

(2) Megacycle dial procedure. - It is very unlikely that the pointer on the MEGACYCLE dial will become inaccurate through normal use of the receiver. However, if the dial pointer has accidently been slipped with respect to the cord, reset it as follows: Take off escutcheon plate; then rotate KILOCYCLE knob counterclockwise until it hits the mechanical stop. Then rotate it a fraction of a turn clockwise until the zero-zero mark lines up with fiducial. From this point rotate KILOCYCLE knob exactly five turns clockwise. Grasp the dial cord and slide the MEGACYCLE pointer along it to the center frequency of the band. For example, if the receiver is set at band 2, set pointer exactly at 2.0 mc. Replace escutcheon plate. Should the position of the drum incorrectly line up the scales with the escutcheon opening, correct by loosening the two set screws on the drum hub and turning drum to correct position.

(3) KILOCYCLE DIAL PROCEDURE. - If the KILOCYCLE dial reading is incorrect first determine the magnitude and direction of the errors and then correct them according to the procedures below.

To determine the nature of the errors, set the receiver on band 2 with the BAND CHANGE knob, and set the KILOCYCLE dial fiducial line to center mark on escutcheon opening by turning the ZERO ADJ. knob. Set the receiver at 1.5 mc by means of the KILOCYCLE knob. Set bfo to exactly 500 kc as in Section 7, paragraph 4.e.(ALTERNATE BFO ALIGNMENT). Turn on the 100-kc calibration oscillator by turning the CAL switch to ON. Turn KILOCYCLE dial to zero beat with the bfo. Note the magnitude and direction of error in KILOCYCLE dial reading (should read zero-zero).

Tune receiver to 2.5 mc. With the bfo set at

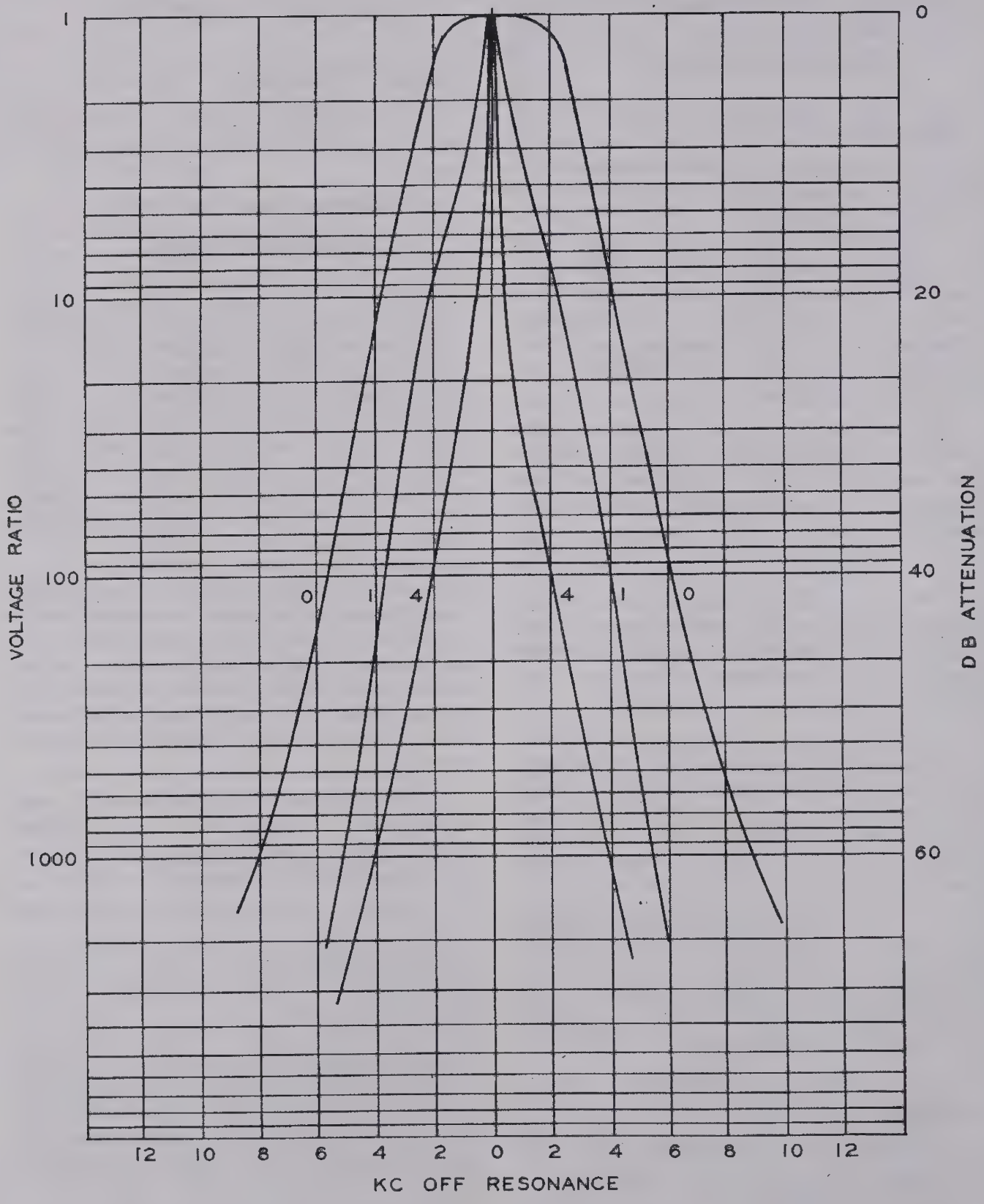


Figure 7-3. I-F Selectivity Curve

exactly 500 kc, turn KILOCYCLE knob to zero beat. Again, note the magnitude and direction of the error in the KILOCYCLE dial reading.

With the magnitude and direction of error at the extreme ends of the dial now recorded, follow appropriate procedure below.

(a) KILOCYCLE DIAL READING ERROR LESS THAN 3 KC IN SAME DIRECTION BY SAME AMOUNT AT BOTH ENDS OF MEGACYCLE DIAL:

1. Be sure bfo is set at 500 kc as in section 7, paragraph 4.e.

2. Tune the receiver to zero beat at some 100-kc check point on the dial.

3. Set KILOCYCLE dial fiducial line to zero-zero on the KILOCYCLE dial by turning the ZERO ADJ knob.

(b) KILOCYCLE DIAL READING ERROR MORE THAN 3 KC IN SAME DIRECTION BY SAME AMOUNT AT BOTH ENDS OF MEGACYCLE DIAL:

1. Be sure bfo is set at 500 kc as in paragraph 4.e. Tune to zero beat at 1.5 mc.

2. Set KILOCYCLE fiducial line to center index mark on the escutcheon opening by turning ZERO ADJ. knob.

3. Keep in mind the magnitude and direction of the dial correction to be made. Loosen set screws in KILOCYCLE dial hub with a #4 Bristol wrench. The position of the shaft may have to be changed to give access to the set screws. The position at which the final set screw is loosened is the reference position. Note the dial reading at this point, and turn the circular dial in the proper direction by the amount of correction needed.

4. Tighten one set screw and check dial reading against zero beat as in paragraph (3) above. NOTE: Inaccessibility of the set screws may present a problem during necessary adjustments of dial positions on the shaft. The adjustments must be made until the error in dial reading is sufficiently small to fall within the range of the ZERO SET control (about 5 kc on either side of the center mark on the escutcheon opening).

(c) KILOCYCLE DIAL READING ERROR EITHER OPPOSITE IN DIRECTION OR DIFFERENT IN MAGNITUDE AT THE ENDS OF THE MEGACYCLE DIAL: (VFO ENDPOINT DRIFT).

1. Be sure bfo is set at 500 kc as in Section 7, paragraph 4.e. Tune to zero beat at 1.5 mc.

2. If the zero-zero mark lies outside the lines on the escutcheon opening, set KILOCYCLE fiducial line to the center line in the escutcheon opening. Loosen set screws in the KILOCYCLE dial and rotate KILOCYCLE dial until zero-zero mark lines up with the fiducial. Tighten set screws.

4. Rotate KILOCYCLE knob approximately ten turns to zero beat. This procedure tunes the receiver to the high end of band 2 at 2.5 mc.

5. Note the error in the KILOCYCLE dial reading. (Should be zero-zero at this point.)

6. IF THIS ERROR IS LESS THAN ±3 KC, set the fiducial to 2.5 mc by turning the ZERO ADJ. knob. This procedure sets the point of maximum accuracy at 2.5 mc. If maximum accuracy is desired near some other check point in the band, tune the receiver to zero beat at the desired check point. Then adjust fiducial to zero-zero on the KILOCYCLE dial.

7. IF THIS ERROR IS MORE THAN ±3 KC, refer to paragraph 4.1. (VFO ALIGNMENT) for instructions.

i. VFO SHAFT POSITION CHECK FOR 100-KC ERROR.

(1) TEST EQUIPMENT NEEDED FOR CHECK.

(a) Signal Generator Set AN/URM-25 Series or equivalent.

(b) Accurately aligned R-388/URR-23A receiver (for alternate method).

(c) #6 Bristo wrenches.

(2) PROCEDURE. - Check the bfo frequency against a known source to determine whether the vfo shaft has been displaced a full turn, and thereby has shifted the vfo frequency exactly 100 kc.

(a) IF A SIGNAL GENERATOR IS USED, set the receiver bfo at exactly 500 kc as in paragraph 4.e. Turn the 100-kc oscillator off. Connect the output of the signal generator to pin 7 of V106 with a clip lead. Set the signal generator at 2.0 mc

and tune the receiver to the input signal by zero beating. (The vfo is now operating at approximately 2.5 mc).

If the vfo shaft is displaced a full turn, zero beat will occur at approximately 1.9 or 2.1 mc instead of 2.0 mc. For exact setting of receiver, remove the signal generator and connect a clip lead from pin 7 of V106 to the 100-kc oscillator output at C173. Turn on the 100-kc oscillator and tune receiver to zero beat with the bfo.

(b) IF AN ACCURATELY ALIGNED R-388/URR-23A, hereafter called the test receiver, is used, couple the antenna jack of the test receiver to the output of the vfo that is being checked. (A few turns in the clip lead placed near the vfo tubes will provide sufficient coupling.) Set the bfo of the test receiver at 500 kc using the 100-kc oscillator in the test receiver as in this section, paragraph 4.e. Tune the test receiver dials to 2.5 mc and check this setting by zero beating the bfo with the 100-kc oscillator as in step (2) (a) above. Turn the test receiver 100-kc oscillator off.

Tune the receiver containing the vfo being checked to where zero beat is observed in the test receiver output. If the shaft of the vfo being checked has been displaced one full turn, zero beat will occur at 1.9 mc or 2.1 mc instead of 2.0 mc.

(c) If steps (a) or (b) reveal that the vfo shaft is displaced a full turn, correct as follows.

1. Note whether zero beat observed by the above steps was above or below the 2.0 mc dial position.

2. Loosen the set screws in vfo coupler with a #6 Bristo wrench.

NOTE

THE KILOCYCLE DIAL MUST BE ROTATED TO DIFFERENT POSITIONS TO PROVIDE ACCESS TO THE VFO COUPLING SET SCREWS. LOOSEN ONE SCREW AND TURN THE SHAFT TO A POSITION WHERE THE SECOND SCREW CAN BE LOOSENED. IMPORTANT--NOTE THE DIAL READING AT THIS POINT BEFORE COMPLETELY UNCOUPLING THE VFO. THE 100-KC CORRECTION WILL USE THIS DIAL SETTING AS A REFERENCE.

3. Hold the vfo shaft rigid at this position and set the receiver dials to read 100 kc higher than the reference setting if zero beat occurred at 1.9 mc or 100 kc lower than the reference setting if zero beat occurred at 2.1 mc.

4. Tighten the coupling set screw which is accessible at this shaft position. Turn the KILOCYCLE dial until the second coupling set screw can be tightened. Tune the receiver dials for zero beat at the 2.0 mc reading.

5. Additional fine adjustment can be made by moving the KILOCYCLE dial on the shaft or by moving the fiducial line on the KILOCYCLE dial opening.

j. VARIABLE I-F AND R-F ALIGNMENTS.

(1) TEST EQUIPMENT NEEDED FOR ALIGNMENTS.

(a) Signal Generator Set AN/URM-25 Series or equivalent.

(b) Electronic voltmeter (Multimeter ME-25/U Series or equivalent.

(c) 47-ohm resistor and 100-uuf capacitor.

NOTE

THE CALIBRATION OSCILLATOR MAY BE USED IF A SIGNAL GENERATOR IS NOT AVAILABLE. USE THE PROCEDURE OUTLINED BELOW BUT LEAVE THE CALIBRATION OSCILLATOR ON. SET THE BFO AT EXACTLY 500 KC AS OUTLINED IN PARAGRAPH 4.e. WITH A CLIP LEAD, COUPLE THE OUTPUT OF THE CALIBRATION OSCILLATOR, AT C173, TO PIN 7 OF V106. TUNE THE RECEIVER TO EACH ALIGNMENT FREQUENCY BY ZERO BEATING WITH THE BFO. (TUNING MAY ALSO BE ACCOMPLISHED BY PEAKING THE INPUT METER IN PLACE OF ZERO BEATING WITH THE BFO.)

(2) PROCEDURE. - Connect the signal generator in series with a 47-ohm resistor and 100-uuf capacitor to the ANTENNA terminal. Connect VTVM between diode load resistor R151 and chassis. Set ANT TRIM to mid-range. Set bfo at exactly 500 kc as in paragraph 4.e. Proceed as follows, referring to figure 7-2 and 7-10 through 7-12 for location of cores and trimmers.

(a) VARIABLE I-F AND R-F BAND 2 ALIGNMENTS.

1. Set Bandswitch to band 2. Set dial to read 1.6 mc.

2. Turn BFO on and set signal generator to zero beat at 1.6 mc. Turn BFO off. Adjust output of signal generator to give some value of diode load voltage below 5 volts. Tune slugs marked 1.6 (in L116, L118, and L102) for a maximum indication while adjusting the signal generator to keep diode load voltage below 5 volts.

3. Set dial to read 2.4 mc. Set generator to zero beat with the bfo at 2.4 mc. Turn BFO off. Tune adjustments marked 2.4 (trimmer capacitors C174, C180, and C104) for a maximum indication, keeping diode load voltage below 5 volts.

4. Repeat tuning procedures at 1.6 and 2.4 mc until no further increase in output can be obtained.

NOTE

IN THE FOLLOWING R-F ALIGNMENT PROCEDURES, KEEP DIODE LOAD VOLTAGE BELOW 5 VOLTS BY ADJUSTING THE SIGNAL GENERATOR OUTPUT, AND BFO SET AT 500 KC.

(b) VARIABLE I-F AND R-F BAND 3 ALIGNMENTS.

1. Set bandswitch to band 3. Set dial to read 2.6 mc. Turn BFO on and set signal generator to zero beat at 2.6 mc. Turn BFO off. Adjust tuning cores marked 2.6 (in L117, L119, and L103) for a maximum indication.

2. Set dial to read 3.4 mc. Set signal generator to zero beat at 3.4 mc with the bfo. Turn BFO off. Adjust trimmer capacitors marked 3.4 (C176, C182, and C106) for maximum indication.

3. Repeat tuning procedures at 2.6 and 3.4 mc until no further increase in output can be obtained.

(c) RF ALIGNMENT BANDS 4-7.

1. Set bandswitch to band 4. Set dial to read 4.0 mc. Turn BFO on and set signal generator to zero beat at 4.0 mc. Turn BFO off. Adjust tuning cores marked 4.0 (in L104, L107, and L111) for maximum indication.

2. Set bandswitch to band 7. Set dial to read 7.0 mc. Turn BFO on and set signal generator to zero beat at 7.0 mc. Turn BFO off. Tune trimmer capacitors marked 7.0 (C108, C120, and C128) for maximum indication.

3. Repeat tuning procedures at 4.0 and 7.0 mc until no further increase in output can be obtained.

(d) RF ALIGNMENT BANDS 8-15.

1. Set bandswitch to band 8. Set dial to read 8.0 mc. Set signal generator to zero beat with the bfo at 8.0 mc. Turn BFO off. Adjust tuning cores marked 8 (in L105, L108, and L112) for maximum indication.

2. Set bandswitch to band 15. Set dial to read 15.0 mc. Set signal generator to zero beat with the bfo at 15.0 mc. Turn BFO off. Tune trimmer capacitors marked 15 (C110, C122, and C130) for maximum indication.

3. Repeat tuning procedures at 8.0 and 15.0 mc until no further increase in output can be obtained.

(e) RF ALIGNMENT BANDS 16-30.

1. Set bandswitch to band 16. Set dial to 16.0 mc. Set signal generator to zero beat with the bfo at 16.0 mc. Turn BFO off. Adjust tuning cores marked 16 (in L106, L109, and L113) for a maximum indication.

2. Set bandswitch to band 30. Set dial to read 30.0 mc. Set signal generator to zero beat with the bfo at 30.0 mc. Turn BFO off. Adjust trimmer capacitors marked 30.0 (C124, C132), and ANT TRIM (front panel) for a maximum indication.

3. Repeat tuning procedures at 16.0 and 30.0 mc until no further increase in output can be obtained.

(f) RF ALIGNMENT BAND 1.

1. Set bandswitch to band 1. Set dial to read 0.6 mc. Set signal generator to zero beat with the bfo at 0.6 mc. Turn BFO off. Adjust core in L114 so that it is in approximately the same position in the inductor as are the cores in L116 and L118. Adjust cores marked 0.6 (in L101 and L110) for a maximum indication. Adjust trimmer capacitor marked 0.6 (C140) for a maximum indication.

NOTE

TWO PEAKS MAY BE FOUND WHEN TUNING C140. USE THE PEAK THAT REQUIRES THE HIGHER VALUE OF CAPACITANCE. REFER TO C140 IN FIGURE 7-2.

2. Set dial to read 1.4 mc. Set signal generator to zero beat with the bfo at 1.4 mc. Turn BFO off. Tune trimmers marked 1.4 (C102 and C119) for a maximum indication. Adjust core marked 1.4 (in L115) for a maximum indication.

3. Repeat tuning procedures at 0.6 and 1.4 mc until no further increase in output can be obtained.

k. SPURIOUS SIGNAL ATTENUATION ADJUSTMENT.

(1) On band 1, where triple conversion is employed, the circuits present a spurious signal when tuned to 1.25 mc. A spurious filter has been inserted in the plate lead of the band 1 mixer to attenuate this signal.

(2) Correct this situation as follows:

(a) Tune the receiver to 1.25 mc. Turn BFO on.

(b) Adjust L124 for the greatest attenuation of the spurious signal. See figure 7-12.

l. VFO ALIGNMENT.

(1) TEST EQUIPMENT NEEDED.

(a) Signal Generator. Set AN/URM-25 Series or equivalent.

(b) Vfo Adjustment tool (not supplied - see figure 7-4).

(2) GENERAL. - During manufacture of the vfo the frequency-determining elements are hermetically sealed within the outer cylindrical cover while held at a high temperature. This drives out practically all moisture and creates a partial vacuum within the sealed compartment. Because of the method of fabrication and the efficiency of design, it is quite unlikely that the vfo will become misaligned through normal use or treatment. However, if it does become sufficiently misaligned, as indicated by the procedure outlined in this Section, paragraph 4.h.(3)(c), it must be returned to the factory for permanent alignment. Because alignment procedure involves breaking of the hermetic seal by removal of a small plug, the future stability of the vfo will be seriously impaired if conditions under which it was manufactured are not duplicated during alignment. Therefore, it is possible to align the vfo only temporarily without sending it back to the factory. If the vfo is to be sent back to the factory refer to paragraph 5 in this section (COMPLETE VFO REMOVAL AND REPLACEMENT) for instructions on removal. This temporary alignment can be performed by a qualified and properly equipped service technician, but should be attempted only in case of emergency. All components not contained within the sealed cover can be maintained in the field.

WARNING

DO NOT, UNDER ANY CIRCUMSTANCES, ATTEMPT TO REMOVE THE OUTER CYLINDRICAL COVER. THIS NOT ONLY BREAKS THE HERMETIC SEAL BUT EXPOSES THE FREQUENCY CORRECTOR MECHANISM AND THE CAREFULLY COMPENSATED FREQUENCY-DETERMINING ELEMENTS.

(3) PROCEDURE.

(a) Before aligning the vfo be sure that the bfo is set at 500 kc as in this section, paragraph 4.e., that the 500-kc i-f channel is aligned, and that the 100-kc oscillator is turned off.

(b) Use a signal generator having an output of 1.5 mc with better than ±25 kc accuracy.

(c) Loosen set screws in the flexible vfo coupler, and slide the coupler hubs apart. Remove the receiver's front panel and the vfo mounting screws. Pull out the vfo and carefully allow it to hang on the connecting wires. Mount a small circular dial on the vfo shaft. This dial must have a linear scale from 0 to 100 completely around its periphery. Affix a small wire for use as a pointer on one of the VFO mounting screws. One division of the dial will equal one kilocycle.

(d) Turn the receiver ON and short the antenna terminal to chassis. Because none of the receiver's variable tuned circuits are used in this procedure, leave the receiver dials at whatever frequency they happen to be on when the receiver is turned on.

(e) Couple the 1.5-mc output from the signal generator to pin 1 of V106.

(f) Find the low frequency endpoint (2.0 mc) of the vfo by turning the vfo shaft clockwise to the last zero beat obtainable in that direction.

CAUTION

DO NOT FORCE THE VFO SHAFT BY ATTEMPTING TO TURN IT FURTHER WHEN IT REACHES THE STOP AT EITHER END OF THE RANGE.

(g) The vfo setting is now within 20 kc of 2.0 mc and must be adjusted more accurately as follows. Uncouple signal generator from pin 1 of V106. Connect a clip lead from the 100-kc oscillator at C173 to pin 1 of V106. Turn 100-kc oscillator on. Carefully rotate vfo shaft to the nearest zero beat. Vfo setting is now exactly 2.0 mc. Place vfo dial pointer at zero, being careful to retain the zero beat setting.

(h) Rotate the vfo shaft exactly 10 turns in a counter-clockwise direction, counting exact turns with the vfo shaft dial. Find zero beat by turning the vfo shaft a few divisions toward either side of the 10-turn mark.

(i) If zero beat occurs on either side of the 10-turn mark, note the magnitude and direction of the error by counting divisions between zero and the pointer. Multiply this number of error divisions by 1.5.

(j) If zero beat occurs at less than 10 turns, rotate the vfo shaft counterclockwise by the number of divisions arrived at in step (i) (1.5 times the error divisions).

(k) If zero beat occurs at more than 10 turns, rotate the vfo shaft clockwise by the number of divisions arrived at in step (i) (1.5 times the error divisions).

(l) Remove the hex plug from the front of the oscillator. Using the outer part of the special vfo adjustment tool illustrated in figure 7-4, loosen the lock nut that is visible when the hex plug is removed. Insert the screwdriver portion of the vfo tool into the outer portion. Adjust the trimmer screw by turning the screwdriver until zero beat is again reached. Tighten lock nut, being careful to retain zero beat.

NOTE

THE TOOL USED FOR THIS ADJUSTMENT IS NOT SUPPLIED, MACHINING DIMENSIONS ARE SHOWN IN FIGURE 7-4.

(m) The high and low end (2.0 and 3.0 mc) zero beat positions should now be exactly ten turns apart. If this is not the case, repeat the above procedure until they are. It will be necessary to zero the dial pointer at the initial zero beat position each time this procedure is repeated. Be sure to tighten the lock nut after making each trimmer adjustment. Be careful not to lose the endpoints by counting incorrectly or forgetting the count. If the endpoints are lost turn off the 100-kc oscillator and start the procedure over at step (e).

(n) After separating the 2.0 and 3.0 mc endpoints of the vfo by exactly 10 turns, replace the hex plug, put the vfo in the receiver and replace the front panel. Align the receiver dials with the vfo according to the procedure outlined in this section, paragraph 5.a.(2)(a). It is not necessary to readjust the r-f and i-f amplifiers for small changes in the vfo adjustment.

(4) EXAMPLES. - The following examples illustrate the procedure outlined in paragraph (3).

NOTE

DO NOT ATTEMPT TO FOLLOW THESE EXAMPLES AS INSTRUCTIONS. THEY ARE PURELY HYPOTHETICAL AND ARE INCLUDED FOR ILLUSTRATIVE PURPOSES ONLY.

(a) Zero the pointer at the low frequency endpoint (2.0 mc) of the vfo. Read zero on the shaft dial. Rotate shaft exactly 10 turns counterclockwise. Again read zero on the dial. A beat note is audible at this setting. Find zero beat by turning vfo shaft by 4 divisions clockwise. This indicates that the endpoints are 4 divisions less than 10 turns apart. Multiply the 4-error divisions by 1.5 to arrive at 6. Rotate vfo shaft counterclockwise by 6 divisions since zero beat occurs at less than 10 turns. Turn trimmer screw to zero beat. Rotate vfo shaft exactly 10 turns clockwise to check whether the endpoints are now exactly 10 turns apart. If they are not, repeat procedure in paragraph (b) until they are.

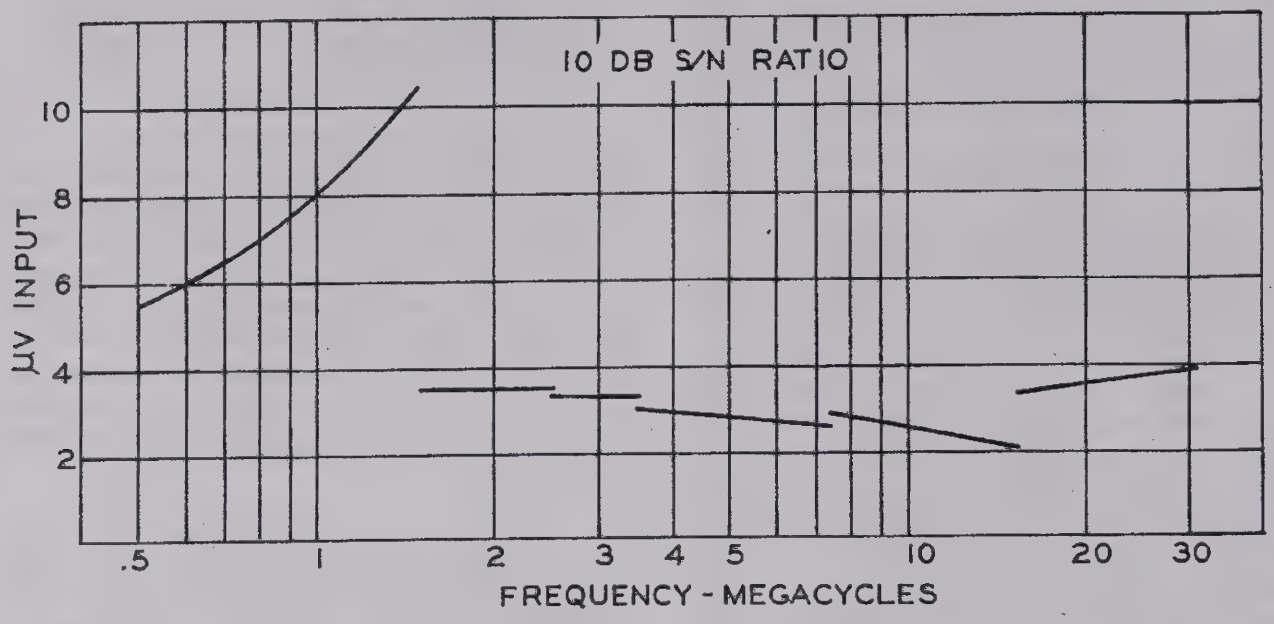


Figure 7-4. VFO Adjustment Tool

(b) Zero the pointer at the low frequency endpoint (2.0 mc) of the vfo. Read zero on the shaft dial. Rotate shaft exactly 10 turns counterclockwise. Again read zero on the dial. A beat note is audible at this setting. Find zero beat by turning bfo shaft by 5 divisions counterclockwise. This indicates that the endpoints are 5 divisions more than 10 turns apart. Multiply the 5 error divisions by 1.5 to arrive at 7.5. Rotate vfo shaft clockwise by 7.5 divisions since zero beat occurs at more than 10 turns. Turn trimmer screw to zero beat. Rotate vfo shaft exactly 10 turns clockwise to check whether the endpoints are now exactly 10 turns apart. If they are not, repeat procedure in paragraph (b) until they are.

m. RECEIVER FINAL TESTING.

(1) SENSITIVITY

(a) Set the controls as follows:

AVC switch	OFF
RF GAIN	Maximum
AUDIO GAIN control	As required for 10:1 signal plus noise-to-noise ratio.
SELECTIVITY	0
LIMITER switch	OFF
BFO	OFF

(b) Apply an r-f signal, modulated 30 percent at 400 cps to the ANTENNA jack through a 47-ohm resistor in series with a 100-uuf capacitor.

(c) Make tests at the low-, middle-, and high-frequency points of each band.

(d) The sensitivity on Band 1 shall be better than 15 uv. The sensitivity on Bands 2 through 30 shall be better than 5 uv. Figure 7-5 illustrates typical measurements throughout the tuning range of the receiver.

(e) The over-all gain on Bands 2 through 30 shall be enough to give one watt of audio output with less than 5 uv input (AVC off).

(f) The c-w sensitivity on Band 1 shall be better than 5 uv and on Bands 2 through 30 the c-w sensitivity shall be better than 1.6 uv.

(2) SIGNAL PLUS NOISE-TO-NOISE RATIO.

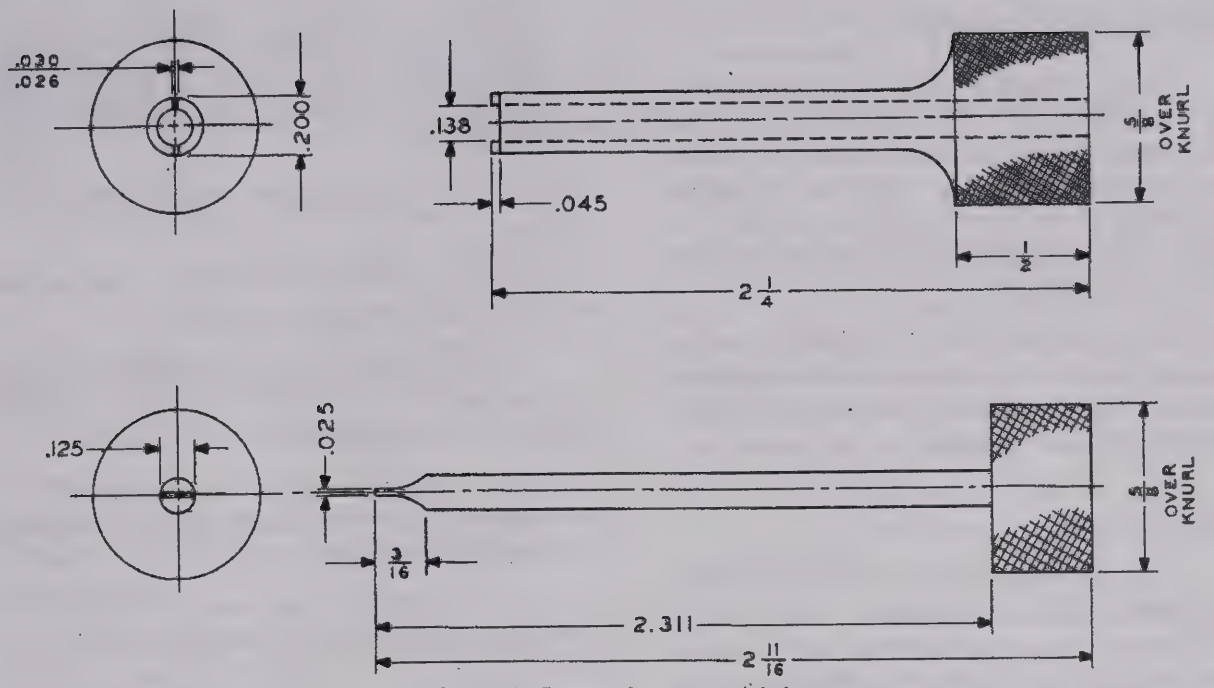


Figure 7-5. Receiver Sensitivity

(a) This test is made most conveniently along with the sensitivity test described above.

(b) After each section of the band is tested as outlined in paragraph (1) above, apply a 1,000 uv signal modulated 30 percent at 400 cps. The AUDIO GAIN should be adjusted to give a 500-mw output.

(c) Turn the generator modulation off-- The noise level should be better than 45-db below the 500-mw level.

(3) AVC CHARACTERISTIC. The avc will begin to take over on Band 1 at a threshold of 6 uv of input signal. On Bands 2 through 30, the avc will begin to take over at a threshold of 3 uv of input signal. For a rise of 0.5 uv of input signal to 125 uv of input signal, the output level should increase no more than 3.5 db. For a rise of 125 uv to 500,000 uv in the input signal, the output level should not increase more than 5 db. For references, apply a 4.9-mc input signal modulated 30 percent at 400 cps to the ANTENNA jack through a series-connected 100-uuf capacitor and a 47-ohm resistor.

5. REPLACEMENT OF PARTS.

a. VFO. - If it is necessary to completely remove the vfo from the receiver for servicing or replacement, employ the following procedure to prevent damage to the unit and to obtain correct alignment with dials when replaced.

(1) VFO REMOVAL.

(a) Remove the front panel and allow it to swing forward on the wires. This will necessitate removal of the KILOCYCLE, BAND CHANGE, AND TRIM, BFO PITCH, SELECTIVITY, and PHASING knobs and the collar, tension washer, and flat washer from the KILOCYCLE shaft, after which the screws holding the panel to the chassis are removed and the front panel allowed to hang to one side on the cable wires.

(b) Loosen set screws on the vfo coupler. Pull coupler apart and remove the center disc.

(c) Mark the vfo connecting wires so that they may be reconnected correctly. Unsolder the wires.

(d) Remove the three screws that hold the vfo to the gear mounting plate. The upper right screw, as viewed from front of plate, is made accessible through a hole in the gear by turning the KILOCYCLE shaft to align the hole over the screw.

(e) Slide the vfo back and tip the rear downward.

(f) Pull the vfo from the receiver.

(2) VFO REPLACEMENT.

(a) To replace a vfo unit in the receiver, reverse the above procedure. Replace the front panel and knobs; reassemble the vfo coupler. Tighten coupler set screws on this VFO but do not tighten the set screws on the front end of the coupler. The procedure used in aligning the vfo with the receiver tuning dials is as follows:

1. Carefully turn the oscillator shaft in a clockwise direction until the stop in the oscillator is reached. (DO NOT FORCE THE SHAFT BEYOND THIS STOP). Back off one turn.

2. Set the receiver dials at 1.5 mc (low end of band 2).

3. Proceed as in section 7, paragraph 4. i. (VFO SHAFT POSITION CHECK FOR 100-KC ERROR). The procedure outlined in paragraph 4. i. implies correct KILOCYCLE dial readings but a full turn (100 kc) error. However this procedure is applicable to correction of any errors between the dial readings and the vfo shaft position. An example of this follows:

EXAMPLE: Suppose in 4. i. (a) or (b), zero beat occurs at a reading of 2.153 mc rather than 2.0 mc (0.153 mc high). At this setting the vfo shaft set screws are not accessible for loosening. The KILOCYCLE dial is turned until the screws can be reached, and at the position where the second screw is loosened the dial readings are 2.0 and 22 (2.022 mc). Since a correction of minus 0.153 mc was indicated from the zero beat dial readings, the vfo shaft is held stationary and the KILOCYCLE dial turned until the reading is 2.022 minus 0.153, or 1.869 mc. This is represented by readings of 1.8 on the MEGACYCLE dial and 69 on the KILOCYCLE dial.

One vfo coupling screw is now tightened without moving the vfo shaft and the shaft is turned until the second screw is accessible for tightening. The dials are then turned to a 2.0 mc reading and zero beat is heard at, or very near, this point. Fine corrections are then made by adjusting the KILOCYCLE dial position on the shaft or by adjusting the ZERO SET control to move the fiducial line to the correct reading point.

b. DIAL CORD REPLACEMENT.

(1) MEGACYCLE POINTER CORD.

(a) Refer to figure 7-6. Remove the front panel as in paragraph 5. a. (1)(a). If the cord is to be replaced, use 36-5/8 inches nylon coated cord. (Parts List Item O-163).

1. Turn kilocycle shaft counterclockwise to stop.

2. Tie a loop in the cord. Loop the cord over the tab at point x in figure 7-6.

3. Wind cord about one-half turn clockwise on pulley A, continue to pulley B, pointer, pulley C, and back to pulley A.

4. Wind cord about 1-1/2 turns clockwise around pulley A. Fasten cord to the spring on pulley A with spring at full tension.

5. Replace front panel, KILOCYCLE dial shaft flat washer, tension washer and collar, and knobs.

(2) DRUM CORD.

(a) If the drum cord has jumped the pulley, restring it without removing the front panel. If the cord is broken, remove the front panel as in paragraph 5. a. (1)(a). Use 27 inches of nylon coated cord, for replacement. (Parts List Item O-163).

1. Turn BAND CHANGE knob to band 30.

2. Turn pulley E, figure 7-6, about one-half turn and hold tension of spring.

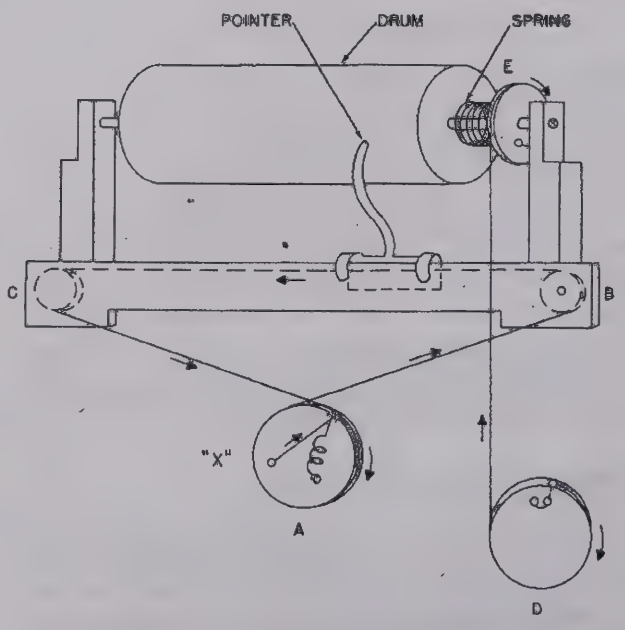


Figure 7-6. Dial Cord Arrangement

3. Insert cord in pulley D and knot it. Wind cord about three fourths of a turn on pulley D; extend to pulley E, and wind it 1-1/2 turns or more around pulley E as needed. Insert cord in hole and knot it.

4. Replace panel and knobs.

5. Turn BAND CHANGE knob to band 15.

6. Loosen set screw in drum hub and turn drum until 15-mc band is centered in the escutcheon opening; then tighten set screw.

c. STATIC DISCHARGE BULB.

(1) Should this bulb fail to fire with the application of 65 volts ac or 90 volts dc, it must be replaced to maintain protection from high voltages on the antenna.

(a) Refer to figure 7-12 for location of bulb in rear-underside of chassis.

(b) Unsolder wires from base of bulb, loosen clamp holding bulb to chassis and remove bulb.

(c) Connect bulb in series with 30K-ohm resistor to 115-volt a-c source, and check to see if bulb fires. If bulb fires, replace in mounting. If bulb fails to fire, replace with new bulb. Bulb description is as follows:

LAMP DESIGNATION	I-104
BULB TYPE	T-4-1/2
BASE TYPE	Bayonet candelabra
RATINGS:	
Watts	1/4 watts nominal
Starting volts	65 volts ac--90 volts dc
Operating volts	105-125 volts ac with 30K-ohms external series resistance

6. MECHANICAL MAINTENANCE.

a. DIAL AND BAND CHANGE GEAR MAINTENANCE.

WARNING

IF DISASSEMBLY OF THE GEAR UNIT IS UNDERTAKEN, INSTRUCTIONS IN PARAGRAPHS 6.a.(1) and 6.a.(2) MUST BE FOLLOWED CLOSELY OR IT WILL BE IMPOSSIBLE TO SYNCHRONIZE THE GEARS UPON REASSEMBLY.

(1) DISASSEMBLY OF GEAR BOX.

(a) If the gear box is to be returned to the factory for servicing, proceed as follows.

1. Set the receiver on its back. Remove the following knobs: SELECTIVITY, PHASING, BFO PITCH, BAND CHANGE, KILOCYCLE tuning, and ANT TRIM. Remove the collar, tension washer and flat washer from the kilocycle shaft. Remove the screws that fasten the front panel to the chassis. Lift the panel off and carefully allow it to hang to one side on the cable wires.

2. Remove the right-hand end bracket from the chassis.

3. Loosen set screws in the following couplers: vfo, r-f slug rack and i-f slug rack shafts, all accessible from the top of the receiver, and two band change shafts, accessible from the bottom.

4. Remove the vfo mounting screws and the gear box mounting screws. Lift the gear box from the receiver.

(b) If repairs are to be made in the field, the gear box may either be removed from the receiver or left in, depending on the extent of repairs. If the box is to be removed, turn the MEGACYCLE knob to its clockwise stop and the KILOCYCLE knob to its counterclockwise stop, and follow the instructions in paragraph 6.a.(1)(a); then proceed according to the following steps. If the box is to be left in the receiver, perform steps 1 and 2 under paragraph 6.a.(1)(a); then proceed according to the following steps. Refer to figures 7-7 and 7-8 for location of gears and shafts.

1. Turn shaft G (BAND CHANGE) clockwise to the stop below band 1. Turn shaft A counterclockwise to the stop.

2. Scribe a mark across the 85-tooth spider gear that carries the planetary gears, and across the 90-tooth stop-pin gear, using the top of the front gear panel as a guide.

3. Scribe a radial mark, precisely under the Geneva wheel spring detent, on the 144-tooth gear that has two stop pins attached.

4. Using the circumference of the Geneva

wheel as a guide, scribe a mark on the 85-tooth gear that drives the Geneva wheel.

5. Scribe a mark through the edge of the small dial cord pulley and the front gear panel.

6. Remove pin from hub of large dial cord pulley.

7. Remove large dial cord pulley and gear.

8. Remove small dial cord pulley.

9. Remove retaining ring from shaft I (shown as shaft Z in the front view of gear plate in figure 7-8).

10. Using a pair of right angle TRUARC pliers or two bent (right angle) scribes, remove retaining ring from shaft F.

11. Using a pair of dividers, measure and record the length of loading spring.

12. Remove four mounting screws from front gear panel.

13. Remove front gear panel, being very careful not to let shafts ride up with plate. While removing this panel do not allow gears to unmesh or rotate.

14. Keep shim washers with respective gears or shafts.

15. Before moving or disengaging any gears other than the 90-tooth gear on shaft F, scribe a line through detent spring, 48-tooth detent gear, and rear gear panel, and another line through the 52-tooth gear on shaft E and rear gear panel.

16. Mark all gears being removed in such a manner that they may be identified later for reassembly.

17. If the overtravel coupler is removed, note that the disc and gear are detented. Do not lose detent ball.

18. Make all necessary repairs. If any parts that have been scribed are to be replaced, be sure to scribe the new parts in exactly the same manner before placing them in the equipment. If the loading cord is to be replaced, form a small loop at one end of each of the two pieces to provide anchors for the spring. Push free ends of the cords through the proper pulley-holes. Knot the free ends after allowing for five-inch lengths of cord between the loops and knots. Coat the knots with Duco cement.

(2) REASSEMBLY OF GEAR BOX. - The following procedure assumes that all gears have been removed, that all repairs have been made, and that the gear and shaft assemblies have been reassembled after repairs were made.

(a) Use AN-G-25 grease on all bearing surfaces during assembly.

(b) If the 74-tooth idler gear whose shaft is riveted to the rear gear panel was removed, replace it first.

(c) Replace a 48-tooth gear and shaft K assembly and shim washers, item J. Replace retaining ring.

(d) Replace 52-tooth gear and shaft E assembly and washer, item G. Line up scribe marks on gear and rear panel. Replace retaining ring.

(e) Replace 48-tooth detent gear, shaft C, detent, and 16-tooth gear assembly. Line up marks on rear panel, 48-tooth gear, and detent spring.

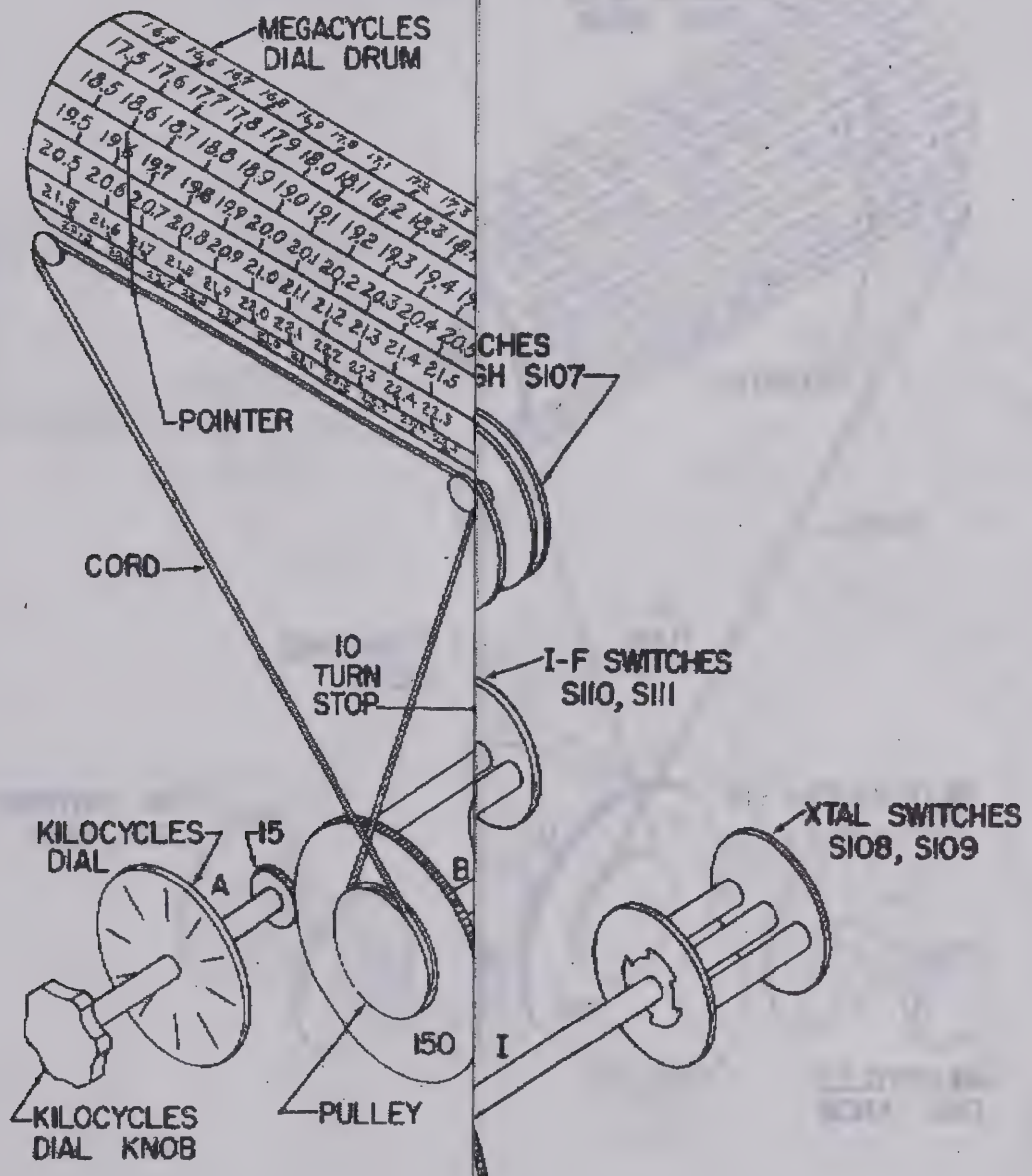
(f) Replace 85-tooth spider gear, 45-tooth, and 25-tooth planetary gear assembly, and shim washer, item AP, on shaft C. Do not move other gears already lined up with the scribe marks.

(g) Replace 48-tooth gear, shaft B, 24-tooth gear assembly, and washers, items C and D as follows:

Wind the loading cord about 1-1/2 turns clockwise on the pulley that is attached to the 52-tooth gear on shaft E. Do not move gears while doing this. Hook spring onto both halves of the loading cord. Insert shaft B into hole on rear plate, but do not yet engage the 48-tooth gear with the detent gear. While holding the 52-tooth gear and shaft E assembly, and the detent gear at their respective scribe marks, rotate shaft B counterclockwise until loading spring stretches to the length measured before disassembly. Engage 48-tooth gear with detent gear while maintaining tension on the loading spring.

(h) Replace the 72-tooth gear and 50-tooth sun gear assembly and shim washer, item W, while holding 85-tooth spider gear so that the scribe mark on it is horizontal (parallel with the top and bottom edges of the gear panels). Keep all other gears set at the scribe marks.

NOTE:
NUMBERS SHOWN ON GEARS
NUMBER OF TEETH.



...nical Functional Diagram

wheel as a guide, scribe a mark on the 85-tooth gear that drives the Geneva wheel.

5. Scribe a mark through the edge of the small dial cord pulley and the front gear panel.

6. Remove pin from hub of large dial cord pulley.

7. Remove large dial cord pulley and gear.

8. Remove small dial cord pulley.

9. Remove retaining ring from shaft I (shown as shaft Z in the front view of gear plate in figure 7-8).

10. Using a pair of right angle TRUARC pliers or two bent (right angle) scribes, remove retaining ring from shaft F.

11. Using a pair of dividers, measure and record the length of loading spring.

12. Remove four mounting screws from front gear panel.

13. Remove front gear panel, being very careful not to let shafts ride up with plate. While removing this panel do not allow gears to unmesh or rotate.

14. Keep shim washers with respective gears or shafts.

15. Before moving or disengaging any gears other than the 90-tooth gear on shaft F, scribe a line through detent spring, 48-tooth detent gear, and rear gear panel, and another line through the 52-tooth gear on shaft E and rear gear panel.

16. Mark all gears being removed in such a manner that they may be identified later for reassembly.

17. If the overtravel coupler is removed, note that the disc and gear are detented. Do not lose detent ball.

18. Make all necessary repairs. If any parts that have been scribed are to be replaced, be sure to scribe the new parts in exactly the same manner before placing them in the equipment. If the loading cord is to be replaced, form a small loop at one end of each of the two pieces to provide anchors for the spring. Push free ends of the cords through the proper pulley-holes. Knot the free ends after allowing for five-inch lengths of cord between the loops and knots. Coat the knots with Duco cement.

(2) REASSEMBLY OF GEAR BOX. - The following procedure assumes that all gears have been removed, that all repairs have been made, and that the gear and shaft assemblies have been reassembled after repairs were made.

(a) Use AN-G-25 grease on all bearing surfaces during assembly.

(b) If the 74-tooth idler gear whose shaft is riveted to the rear gear panel was removed, replace it first.

(c) Replace a 48-tooth gear and shaft K assembly and shim washers, item J. Replace retaining ring.

(d) Replace 52-tooth gear and shaft E assembly and washer, item G. Line up scribe marks on gear and rear panel. Replace retaining ring.

(e) Replace 48-tooth detent gear, shaft C, detent, and 16-tooth gear assembly. Line up marks on rear panel, 48-tooth gear, and detent spring.

(f) Replace 85-tooth spider gear, 45-tooth, and 25-tooth planetary gear assembly, and shim washer, item AP, on shaft C. Do not move other gears already lined up with the scribe marks.

(g) Replace 48-tooth gear, shaft B, 24-tooth gear assembly, and washers, items C and D as follows:

Wind the loading cord about 1-1/2 turns clockwise on the pulley that is attached to the 52-tooth gear on shaft E. Do not move gears while doing this. Hook spring onto both halves of the loading cord. Insert shaft B into hole on rear plate, but do not yet engage the 48-tooth gear with the detent gear. While holding the 52-tooth gear and shaft E assembly, and the detent gear at their respective scribe marks, rotate shaft B counterclockwise until loading spring stretches to the length measured before disassembly. Engage 48-tooth gear with detent gear while maintaining tension on the loading spring.

(h) Replace the 72-tooth gear and 50-tooth sun gear assembly and shim washer, item W, while holding 85-tooth spider gear so that the scribe mark on it is horizontal (parallel with the top and bottom edges of the gear panels). Keep all other gears set at the scribe marks.

NOTE:
NUMBERS SHOWN ON GEARS INDICATE NUMBER OF TEETH.

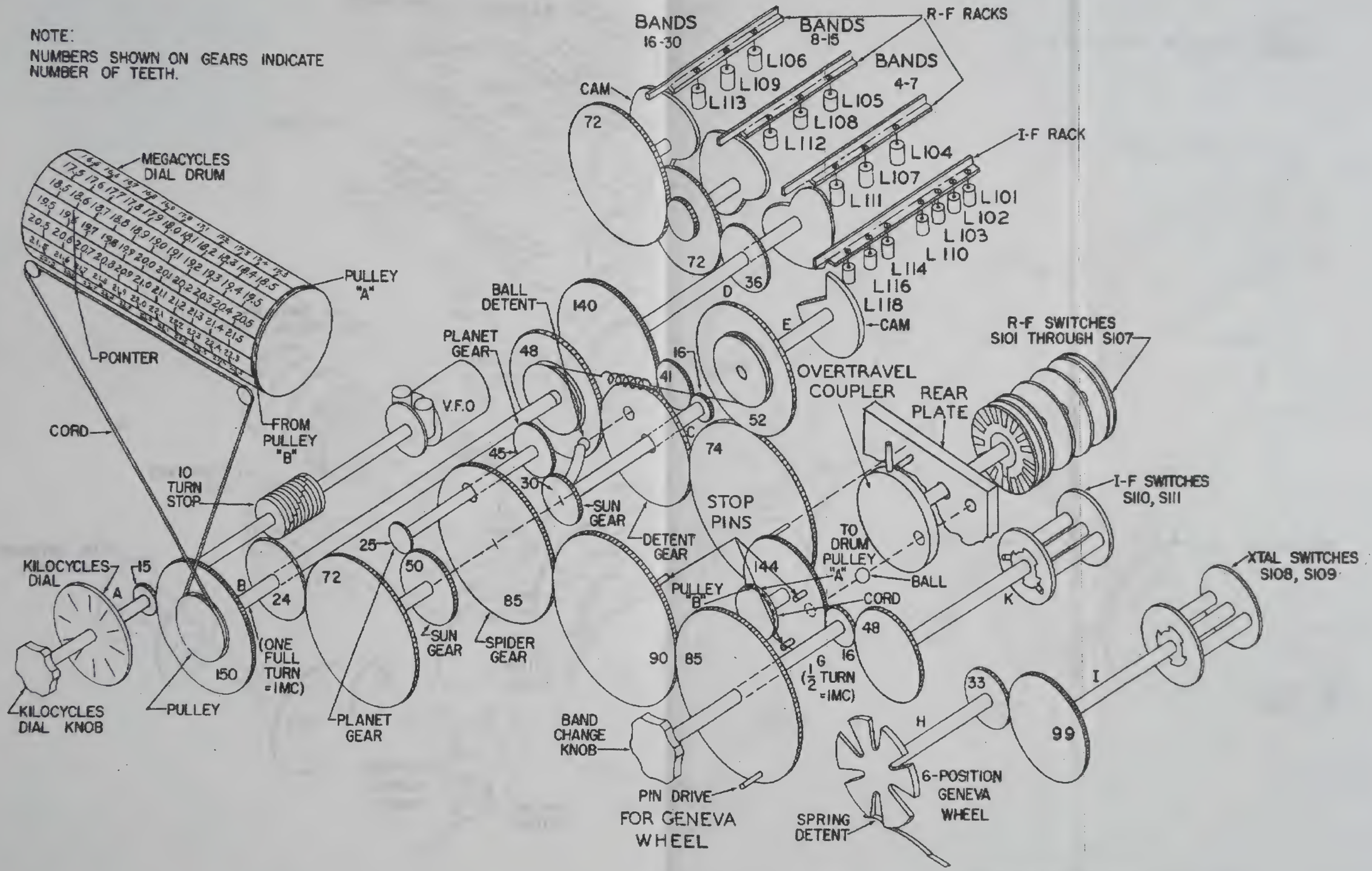
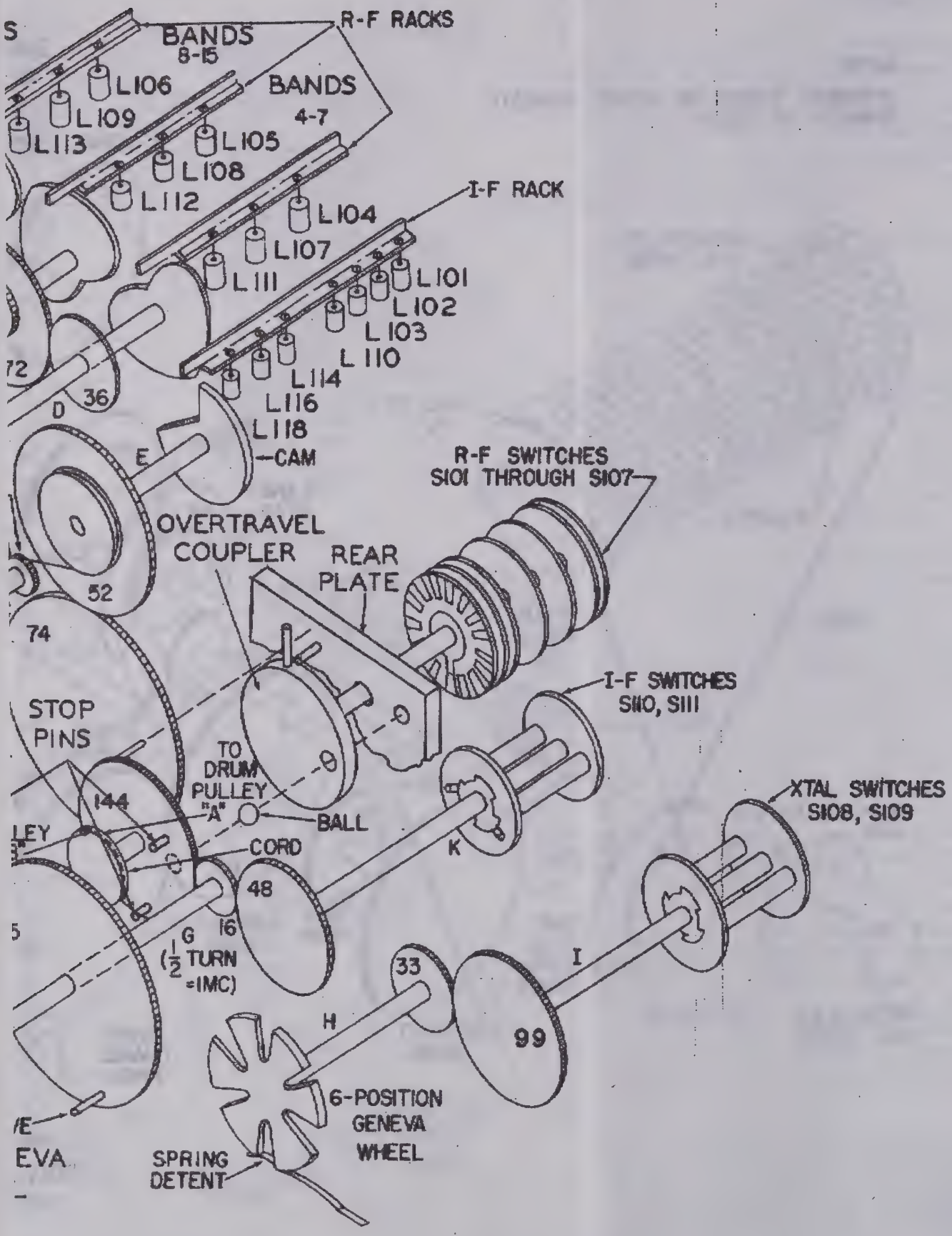
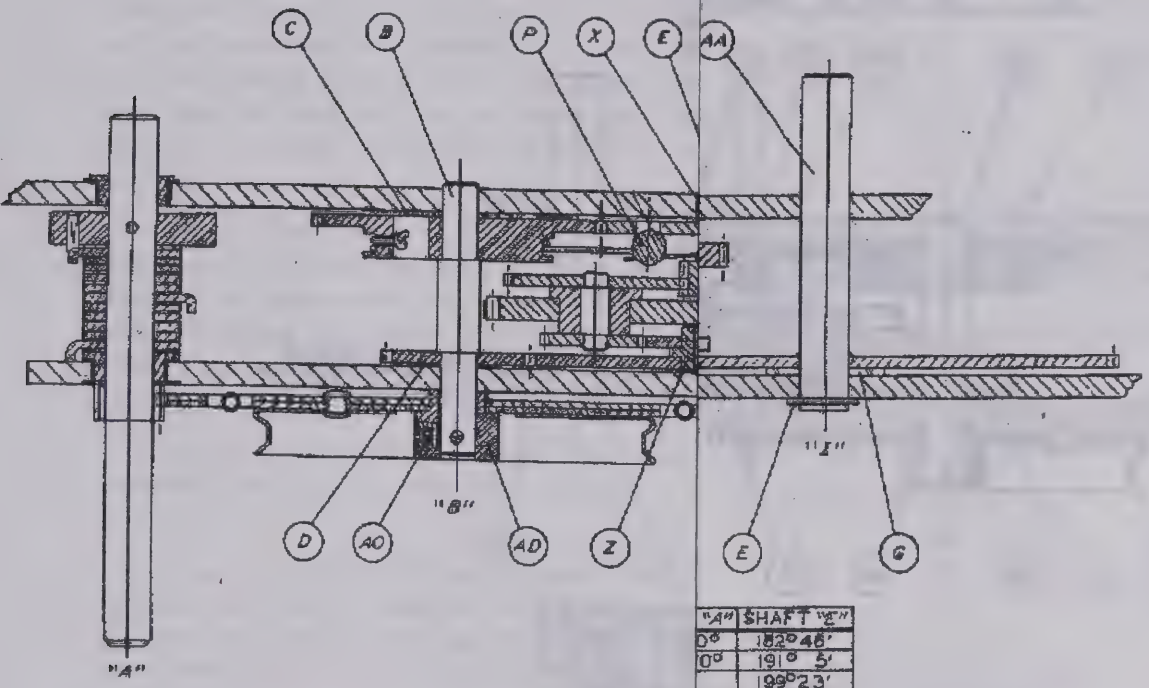


Figure 7-7. Mechanical Functional Diagram


R-F RACKS
BANDS 8-15
BANDS 4-7
L106
L109
L113
L105
L108
L112
I-F RACK
L104
L107
L111
L101
L102
L103
L110
L114
L116
L118
CAM
R-F SWITCHES S101 THROUGH S107
OVERTRAVEL COUPLER
REAR PLATE
I-F SWITCHES S110, S111
XTAL SWITCHES S108, S109
STOP PINS
TO DRUM PULLEY "A"
BALL
CORD
144
48
16
G
(½ TURN =1MC)
K
I
33
99
H
6-POSITION GENEVA WHEEL
SPRING DETENT
72
36
D
E
0
52
74
5

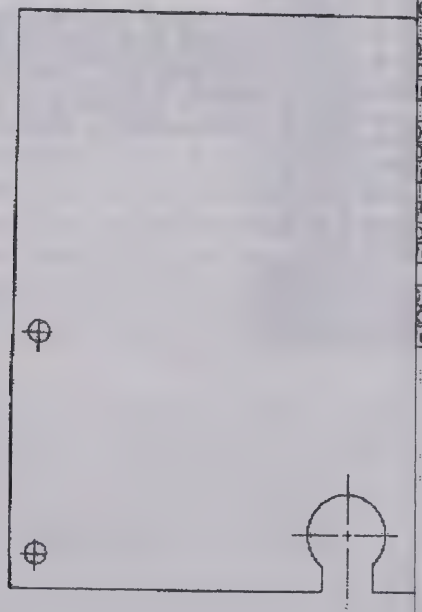
ITEM NO.	QUANTITY	PART NO.	ASSY
A	1	505 2179 003	BACK
B	1	504 3111 002	REV. G
C	1	504 2973 001	WASHI
D	2	500 2112 002	WASH
E	4	340 0025 00	RETAI
F	1	504 3014 001	I.F. DR
G	2	500 1081 003	WASHE
H	1	504 3004 001	GEAR
J	2	500 1109 003	WASHI REW
K	1	340 0013 00	RETAI
L	1	504 2956 001	MC KI
M	1	504 3013 001	KNOB
N	1	311 1122 30	GROOV

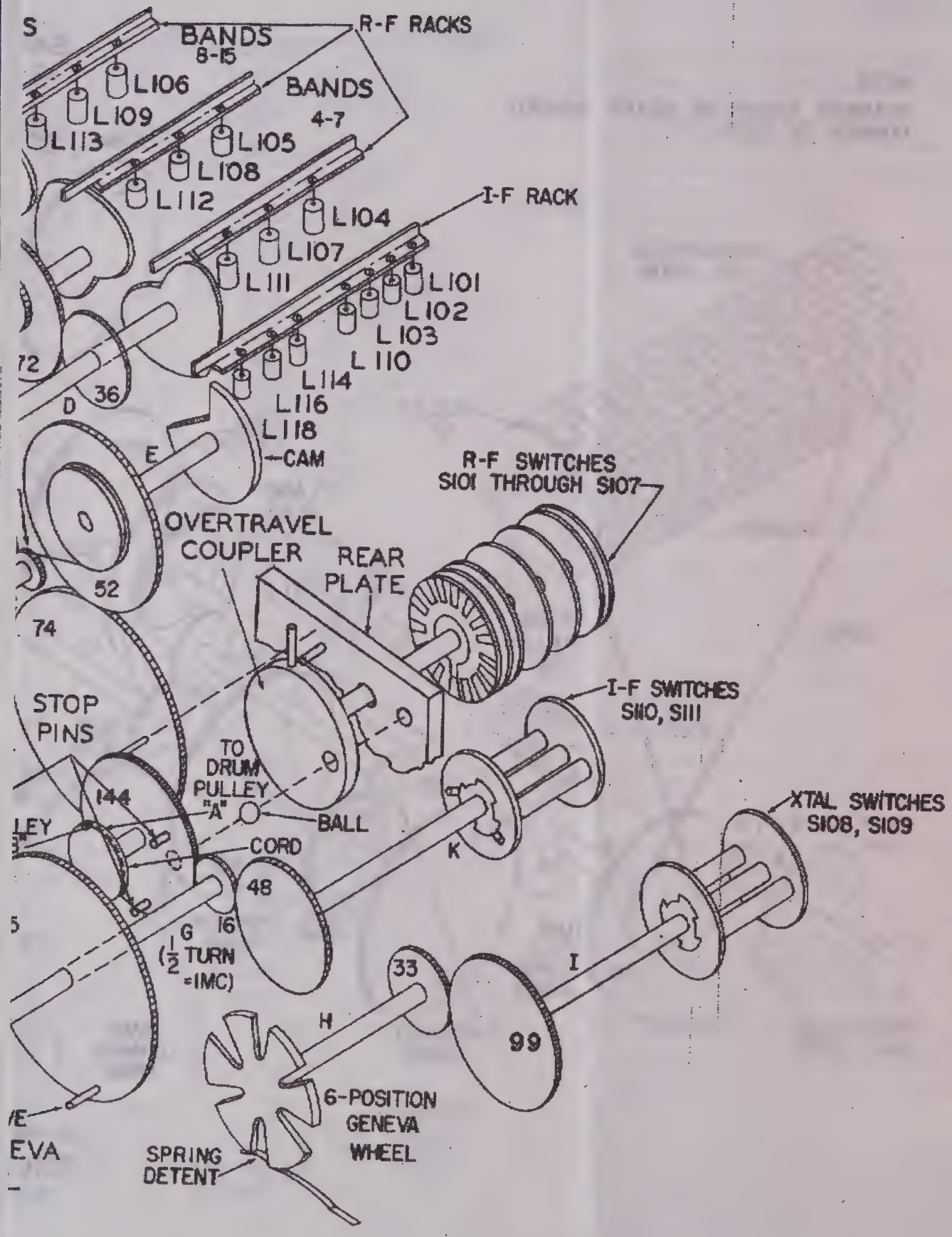
NOTE:-
CROSS-SECTIONAL DETAIL AT LEFT IS NOT A TRUE LAYOUT.
SHAFTS ARE LOCATED TO SHOW GEAR MESH.
FOR TRUE LOCATION OF SHAFTS, GEARS AND PINS, REFER TO FRONT VIEW OF ASSEMBLY BELOW.



"A"	SHAFT "E"
0°	182° 46'
0°	191° 5'
	199° 23'
0°	207° 42'
0°	216°
0°	224° 18'
	232° 37'
0°	240° 55'
0°	249° 14'
0°	257° 32'
	265° 51'
0°	274° 9'
0°	282° 28'
0°	290° 46'
	299° 5'
0°	307° 23'
0°	315° 42'
0°	324°
	332° 18'
0°	340° 37'
0°	348° 55'
0°	357° 14'

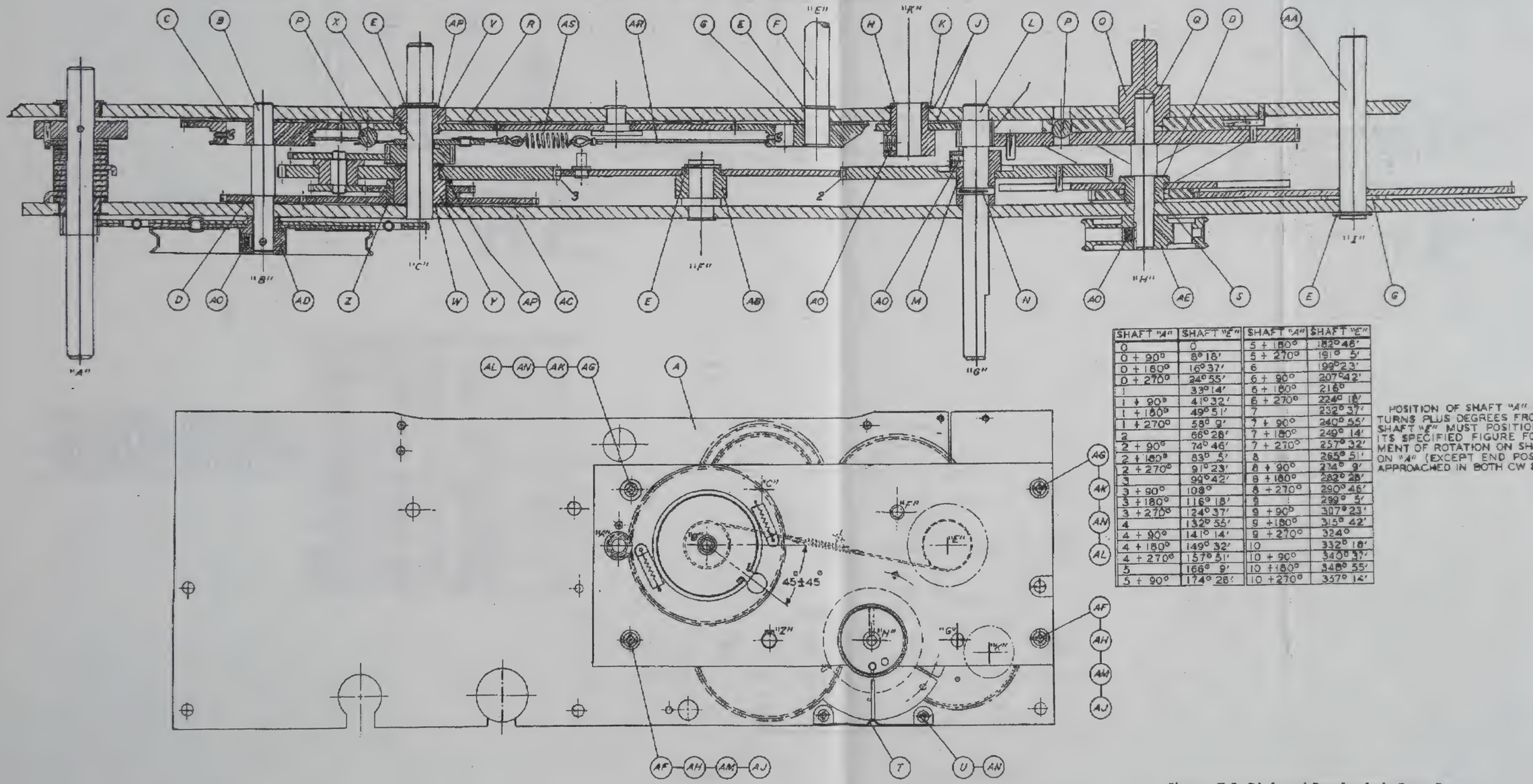
POSITION OF SHAFT "A" GIVEN IN NO. OF TURNS PLUS DEGREES FROM CCW STOP. SHAFT "E" MUST POSITION WITHIN 27' OF ITS SPECIFIED FIGURE FOR EACH INCREMENT OF ROTATION ON SHAFT "A" SETTINGS ON "A" (EXCEPT END POSITIONS) TO BE APPROACHED IN BOTH CW & CCW DIRECTIONS.




BANDS 8-15
R-F RACKS
BANDS 4-7
L106
L109
L113
L105
L108
L112
I-F RACK
L104
L107
L111
L101
L102
L103
L110
L114
L116
L118
CAM
R-F SWITCHES S101 THROUGH S107
OVERTRAVEL COUPLER
REAR PLATE
I-F SWITCHES S110, S111
STOP PINS
TO DRUM PULLEY "A"
BALL
CORD
XTAL SWITCHES S108, S109
6-POSITION GENEVA WHEEL
SPRING DETENT
72
36
D
E
52
74
144
48
16
G
(½ TURN =1MC)
33
99
H
I
K

ITEM NO.	QUANTITY	PART NO.	PART NAME
A	1	505 2179 003	BACK GEAR PANEL ASSY
B	1	504 3111 002	REV. GEARS & SHAFT ASSY
C	1	504 2973 001	WASHER
D	2	500 2112 002	WASHER
E	4	340 0025 00	RETAINING RING
F	1	504 3014 001	I.F. DRIVER GEAR & SHAFT ASSY
G	2	500 1081 003	WASHER
H	1	504 3004 001	GEAR ASSY-SWITCH, I.F.
J	2	500 1109 003	WASHER
K	1	340 0013 00	RETAINING RING
L	1	504 2956 001	MC KNOB SHAFT
M	1	504 3013 001	KNOB GEAR & HUB ASSY
N	1	311 1122 30	GROOVE PIN
O	1	504 3006 001	SHAFT ASSY-BAND SWITCH
P	2	309 5200 00	BALL-3/16 DIA.
Q	1	504 3012 001	SHAFT ASSY-GENEVA WHEEL
R	1	504 2972 001	THRUST BEARING
S	1	504 3015 001	HUB ASSY-GENEVA WHEEL
T	1	504 2932 001	CENTERING SPRING
U	2	343 0165 00	6-32 X 1/8 PBH SCREW
V	1	504 3018 001	HUB ASSY-DETENT GEAR
W	1	504 2974 001	WASHER
X	1	504 3025 001	DETENT SPRING ASSY
Y	1	504 3020 001	CENTER PLANET-GEAR & HUB ASSY
Z	1	504 3016 001	HUB ASSY-FLOATING
AA	1	504 3005 001	SHAFT & GEAR ASSY
AB	1	504 3009 001	STOP IDLER GEAR HUB ASSY
AC	1	505 2180 003	FRONT GEAR PANEL ASSY
AD	1	504 5645 002	POINTER PULLEY ASSY
AE	1	504 2954 001	PULLEY-DRUM
AF	2	505 2128 001	STANDOFF-LOWER
AG	2	505 2127 001	STANDOFF-UPPER
AH	4	343 0166 00	8-32 X 5/16 SCREW
AJ	4	310 6380 00	WASHER #8 FLAT
AK	4	343 0167 00	8-32 X 1/4 SCREW
AL	4	310 6360 00	WASHER #6 FLAT
AM	4	373 0003 00	WASHER #8 SHAKE
AN	6	373 0001 00	WASHER #6 SHAKE
AO	6	326 0002 00	6-40 X 1/8 SET SCREW
AP	4	500 1112 003	WASHER
AR	1	432 1011 00	LOADING CORD FT.
AS	1	502 1158 002	SPRING

NOTE:-
CROSS-SECTIONAL DETAIL AT LEFT IS NOT A TRUE LAYOUT.
SHAFTS ARE LOCATED TO SHOW GEAR MESH.
FOR TRUE LOCATION OF SHAFTS, GEARS AND PINS, REFER TO FRONT VIEW OF ASSEMBLY BELOW.



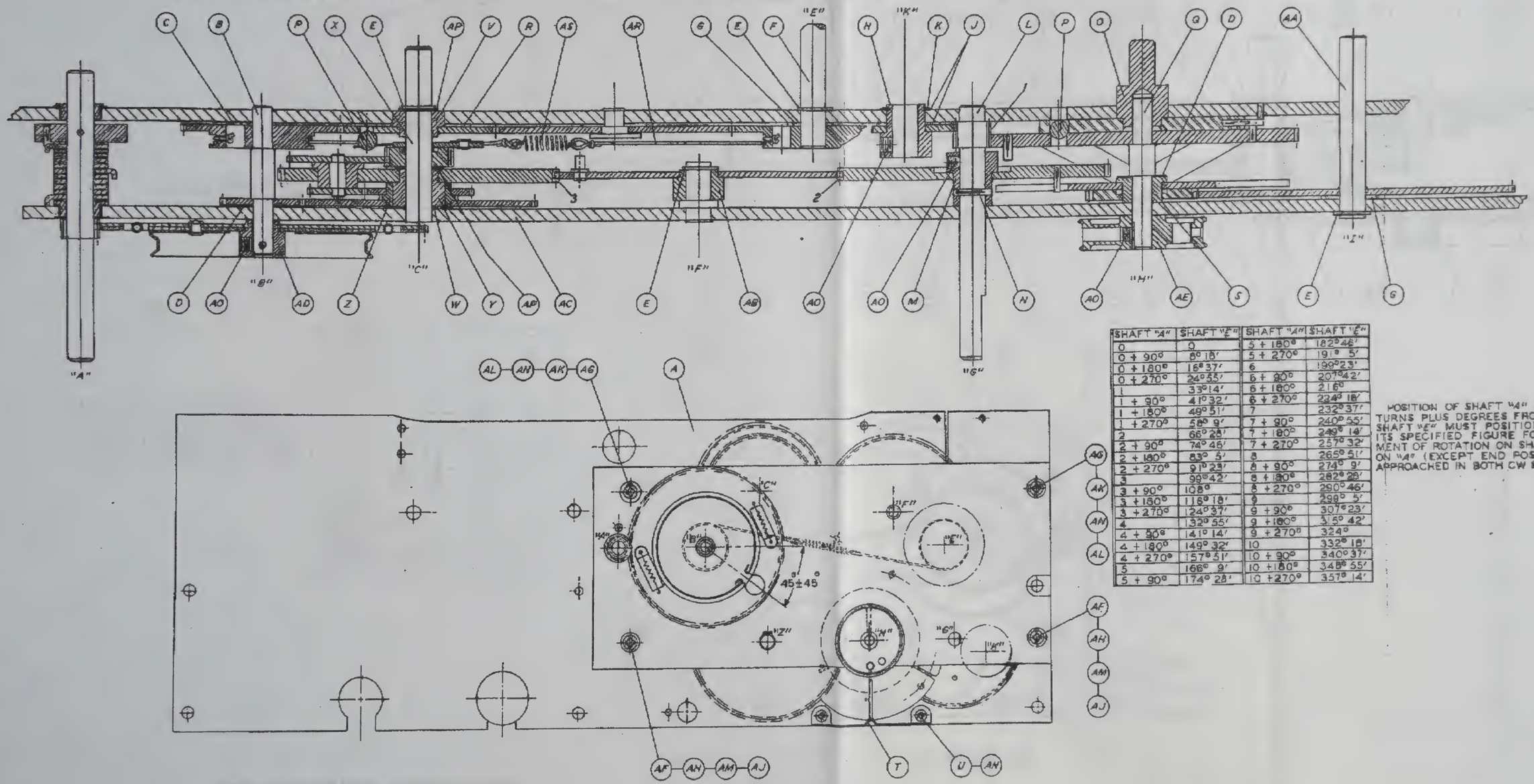
SHAFT "A"	SHAFT "E"	SHAFT "A"	SHAFT "E"
0	0	5 + 180°	182° 46'
0 + 90°	8° 18'	5 + 270°	191° 5'
0 + 180°	16° 37'	6	199° 23'
0 + 270°	24° 55'	6 + 90°	207° 42'
1	33° 14'	6 + 180°	216°
1 + 90°	41° 32'	6 + 270°	224° 18'
1 + 180°	49° 51'	7	232° 37'
1 + 270°	58° 9'	7 + 90°	240° 55'
2	66° 28'	7 + 180°	249° 14'
2 + 90°	74° 46'	7 + 270°	257° 32'
2 + 180°	83° 5'	8	265° 51'
2 + 270°	91° 23'	8 + 90°	274° 9'
3	99° 42'	8 + 180°	282° 28'
3 + 90°	108°	8 + 270°	290° 46'
3 + 180°	116° 18'	9	299° 5'
3 + 270°	124° 37'	9 + 90°	307° 23'
4	132° 55'	9 + 180°	315° 42'
4 + 90°	141° 14'	9 + 270°	324°
4 + 180°	149° 32'	10	332° 18'
4 + 270°	157° 51'	10 + 90°	340° 37'
5	166° 9'	10 + 180°	348° 55'
5 + 90°	174° 28'	10 + 270°	357° 14'

POSITION OF SHAFT "A" GIVEN IN NO. OF TURNS PLUS DEGREES FROM CCW STOP. SHAFT "E" MUST POSITION WITHIN 27' OF ITS SPECIFIED FIGURE FOR EACH INCREMENT OF ROTATION ON SHAFT "A" SETTINGS ON "A" (EXCEPT END POSITIONS) TO BE APPROACHED IN BOTH CW & CCW DIRECTIONS.

Figure 7-8. Dial and Bandswitch Gear Box

ITEM NO.	QUANTITY	PART NO.	PART NAME
A	1	505 2179 003	BACK GEAR PANEL ASSY
B	1	504 3111 002	REV. GEARS & SHAFT ASSY
C	1	504 2973 001	WASHER
D	2	500 2112 002	WASHER
E	4	340 0025 00	RETAINING RING
F	1	504 3014 001	I.F. DRIVER GEAR & SHAFT ASSY
G	2	500 1081 003	WASHER
H	1	504 3004 001	GEAR ASSY-SWITCH, I.F.
J	2	500 1109 003	WASHER
K	1	340 0013 00	RETAINING RING
L	1	504 2956 001	MC KNOB SHAFT
M	1	504 3013 001	KNOB GEAR & HUB ASSY
N	1	311 1123 30	GROOVE PIN
O	1	504 3006 001	SHAFT ASSY-BAND SWITCH
P	2	309 5200 00	BALL-3/16 DIA.
Q	1	504 3012 001	SHAFT ASSY-GENEVA WHEEL
R	1	504 2972 001	THRUST BEARING
S	1	504 3015 001	HUB ASSY-GENEVA WHEEL
T	1	504 2932 001	CENTERING SPRING
U	2	343 0165 00	6-32 X 1/8 PBH SCREW
V	1	504 3018 001	HUB ASSY-DETENT GEAR
W	1	504 2974 001	WASHER
X	1	504 3025 001	DETENT SPRING ASSY
Y	1	504 3020 001	CENTER PLANET-GEAR & HUB ASSY
Z	1	504 3016 001	HUB ASSY-FLOATING
AA	1	504 3005 001	SHAFT & GEAR ASSY
AB	1	504 3009 001	STOP IDLER GEAR HUB ASSY
AC	1	505 2180 003	FRONT GEAR PANEL ASSY
AD	1	504 5645 002	POINTER PULLEY ASSY
AE	1	504 2954 001	PULLEY-DRUM
AF	2	505 2128 001	STANDOFF-LOWER
AG	2	505 2127 001	STANDOFF-UPPER
AH	4	343 0186 00	6-32 X 5/16 SCREW
AJ	4	310 6380 00	WASHER #8 FLAT
AK	4	343 0167 00	6-32 X 1/4 SCREW
AL	4	310 6360 00	WASHER #6 FLAT
AM	4	373 0003 00	WASHER #8 SHAKE
AN	6	373 0001 00	WASHER #6 SHAKE
AO	6	328 0002 00	6-40 X 1/8 SET SCREW
AP	4	500 1112 003	WASHER
AR	1	432 1011 00	LOADING CORD FT.
AS	1	502 1158 002	SPRING

NOTE:-
CROSS-SECTIONAL DETAIL AT LEFT IS NOT A TRUE LAYOUT.
SHAFTS ARE LOCATED TO SHOW GEAR MESH.
FOR TRUE LOCATION OF SHAFTS, GEARS AND PINS, REFER TO FRONT VIEW OF ASSEMBLY BELOW.



SHAFT "A"	SHAFT "E"	SHAFT "A"	SHAFT "E"
0	0	5 + 180°	182° 46'
0 + 90°	8° 18'	5 + 270°	191° 5'
0 + 180°	16° 37'	6	199° 23'
0 + 270°	24° 55'	6 + 90°	207° 42'
1	33° 14'	6 + 180°	216°
1 + 90°	41° 32'	6 + 270°	224° 18'
1 + 180°	49° 51'	7	232° 37'
1 + 270°	58° 9'	7 + 90°	240° 55'
2	66° 28'	7 + 180°	249° 14'
2 + 90°	74° 46'	7 + 270°	257° 32'
2 + 180°	83° 5'	8	265° 51'
2 + 270°	91° 23'	8 + 90°	274° 9'
3	99° 42'	8 + 180°	282° 28'
3 + 90°	108°	8 + 270°	290° 46'
3 + 180°	116° 18'	9	299° 5'
3 + 270°	124° 37'	9 + 90°	307° 23'
4	132° 55'	9 + 180°	315° 42'
4 + 90°	141° 14'	9 + 270°	324°
4 + 180°	149° 32'	10	332° 18'
4 + 270°	157° 51'	10 + 90°	340° 37'
5	166° 9'	10 + 180°	348° 55'
5 + 90°	174° 28'	10 + 270°	357° 14'

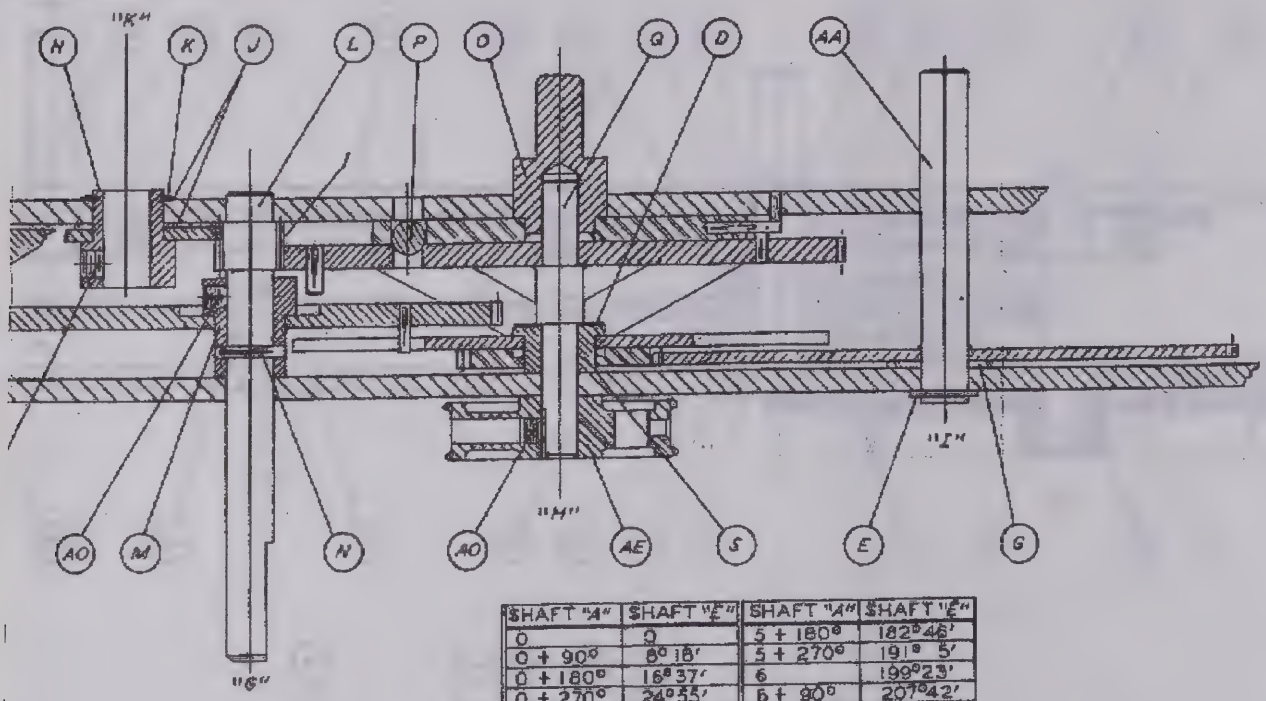
POSITION OF SHAFT "A" GIVEN IN NO. OF TURNS PLUS DEGREES FROM CCW STOP. SHAFT "E" MUST POSITION WITHIN 2° OF ITS SPECIFIED FIGURE FOR EACH INCREMENT OF ROTATION ON SHAFT "A" SETTINGS ON "A" (EXCEPT END POSITIONS) TO BE APPROACHED IN BOTH CW & CCW DIRECTIONS.

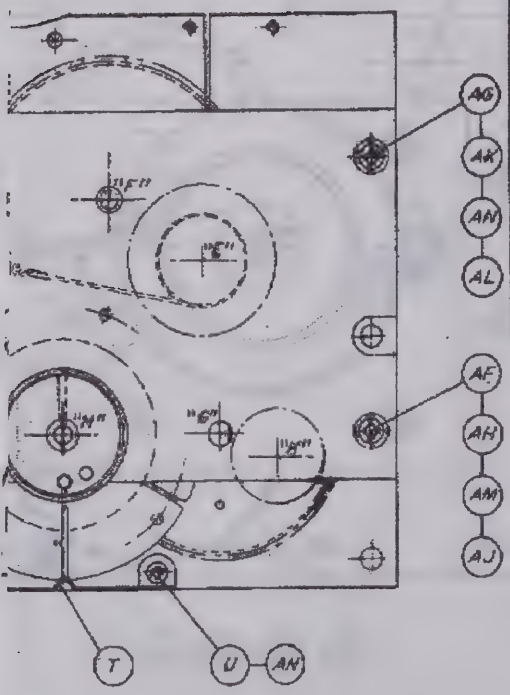
Figure 7-8. Dial and Bandswitch Gear Box

AND SWITCH	
A.	
ENEVA WHEEL	
NG	
NEVA WHEEL	
RING	
H SCREW	
TENT GEAR	
G ASSY	
T-GEAR & HUB ASSY	
DATING	
ASSY	
EAR HUB ASSY	
ANEL ASSY	

AD	1	504 5645 002	POINTER PULLEY ASSY
AE	1	504 2954 001	PULLEY-DRUM
AF	2	505 2128 001	STANDOFF-LOWER
AG	2	505 2127 001	STANDOFF-UPPER
AH	4	343 0186 00	8-32 X 5/16 SCREW
AJ	4	310 6380 00	WASHER #8 FLAT
AK	4	343 0167 00	6-32 X 1/4 SCREW
AL	4	310 6360 00	WASHER #6 FLAT
AM	4	373 0003 00	WASHER #8 SHAKE
AN	6	373 0001 00	WASHER #6 SHAKE
AO	6	328 0002 00	6-40 X 1/8 SET SCREW
AP	4	500 1112 003	WASHER
AR	1	432 1011 00	LOADING CORD FT.
AS	1	502 1158 002	SPRING

NOTE:-
CROSS-SECTIONAL DETAIL AT LEFT IS NOT A TRUE LAYOUT.
SHAFTS ARE LOCATED TO SHOW GEAR MESH.
FOR TRUE LOCATION OF SHAFTS, GEARS AND PINS, REFER TO FRONT VIEW OF ASSEMBLY BELOW.





SHAFT "A"	SHAFT "E"	SHAFT "A"	SHAFT "E"
0	0	5 + 180°	182° 46'
0 + 90°	8° 18'	5 + 270°	191° 5'
0 + 180°	16° 37'	6	199° 23'
0 + 270°	24° 55'	6 + 90°	207° 42'
1	33° 14'	6 + 180°	216°
1 + 90°	41° 32'	6 + 270°	224° 18'
1 + 180°	49° 51'	7	232° 37'
1 + 270°	58° 9'	7 + 90°	240° 55'
2	66° 28'	7 + 180°	249° 14'
2 + 90°	74° 46'	7 + 270°	257° 32'
2 + 180°	83° 5'	8	265° 51'
2 + 270°	91° 23'	8 + 90°	274° 9'
3	99° 42'	8 + 180°	282° 28'
3 + 90°	108°	8 + 270°	290° 46'
3 + 180°	116° 18'	9	299° 5'
3 + 270°	124° 37'	9 + 90°	307° 23'
4	132° 55'	9 + 180°	315° 42'
4 + 90°	141° 14'	9 + 270°	324°
4 + 180°	149° 32'	10	332° 18'
4 + 270°	157° 51'	10 + 90°	340° 37'
5	166° 9'	10 + 180°	348° 55'
5 + 90°	174° 28'	10 + 270°	357° 14'

POSITION OF SHAFT "A" GIVEN IN NO. OF TURNS PLUS DEGREES FROM CCW STOP. SHAFT "E" MUST POSITION WITHIN 27' OF ITS SPECIFIED FIGURE FOR EACH INCREMENT OF ROTATION ON SHAFT "A". SETTINGS ON "A" (EXCEPT END POSITIONS) TO BE APPROACHED IN BOTH CW & CCW DIRECTIONS.

(i) Reassemble overtravel disc with the 144-tooth overtravel gear. Detent the two together with detent ball. Use AN-G-25 grease to hold ball in place.

(j) Replace overtravel assembly, lining up mark on overtravel gear with notch on Geneva detent spring.

(k) Replace 85-tooth gear, shaft G, and 16-tooth gear assembly, lining up a arcuate scribe mark with circumference of overtravel gear. This mark will later line up with the Geneva wheel, but at present it is concentric with the overtravel gear. Make sure that alignment described in step (h) is maintained.

(l) Replace Geneva wheel and 33-tooth gear assembly and shim washer, item D. Be sure Geneva drive pin is engaged with slot in the Geneva wheel while the Geneva wheel detent is engaged, and that the arcuate scribe mark on the 85-tooth drive gear lines up with the circumference of the Geneva wheel.

(m) Replace 99-tooth gear and shaft I assembly, and washer, item G. Position is not critical.

(n) Lay the 90-tooth stop-pin gear in position with the scribe mark horizontal across the top, and collinear with scribe mark on the 85-tooth spider gear (parallel to the top and bottom edges of the gear panels).

(o) Replace front gear panel as follows: While sliding the panel into position, slide the 90-tooth stop-pin gear on its shaft which is attached to the front panel, being careful to keep scribe mark lined up with the mark on the 85-tooth spider gear. Also keep arcuate mark on the 85-tooth Geneva drive gear lined up with the circumference of the Geneva wheel. Further, keep the mark on the 144-tooth overtravel coupler gear lined up with notch in the Geneva wheel detent. Replace screws in front gear panel.

(p) Check operation of the BAND CHANGE gear. If the gear box has been removed from the receiver, make the check while holding the gear box in a horizontal plane with the front gear panel facing down, so that the 90-tooth stop-pin gear will not fall off during the check. If the gear box has not been removed from the receiver, replace the retaining ring on the 90-tooth stop-pin gear shaft before making the check. Then, in either case, proceed as follows:

1. Shaft G should now be against the clockwise stop, and should detent when turned counterclockwise approximately 45°. The ball on shaft C will now detent shaft G every 180°.

2. When shaft G is turned counterclockwise 7-1/2 revolutions, or 15 detent positions from the first detent position, the pin in the 144-tooth gear on shaft H (figure 7-8), and the radial pin on the overtravel disc rotate clockwise until the radial pin just touches or is about to touch the pin in the rear gear panel. Further rotation of shaft G causes the pin in the gear to leave the radial pin that was stopped by the pin in the rear gear panel. Thus the overtravel coupler output shaft, which drives r-f switches S101 through S107 (figure 7-7), rotates 300° for the first 16 detent positions of shaft G and remains at that setting for further counterclockwise rotation of shaft G.

3. Shaft G should rotate 14 more detent positions or 7 revolutions from the sixteenth detent position, and should hit the counterclockwise stop approximately 45° past the thirtieth detent position. If the stop pins intersect before this, adjust them by changing phase relations of the gears at points 1, 2, and 3, shown in figure 7-8. Before deciding to change the relative positions of these gears, double check the conditions in steps 1, 2, and 3. If instructions in paragraphs 6.a.(1) and 6.a.(2) were followed precisely, operation of the BAND CHANGE gear train should meet the conditions set forth in these steps.

4. The Geneva wheel should turn one notch when shaft G turns counterclockwise from an even-numbered to an odd-numbered detent position. (Count the first detent position from the clockwise stop as number 1.) Thus shaft I should rotate through 14 positions, or 280°, for 30 detent positions, or 14-1/2 turns, of shaft G. The initial position of shaft I should correspond to detent positions 1 and 2 of shaft G, the second shaft I position should correspond to detent positions 3 and 4 of shaft G, and so on through to the thirtieth detent position of shaft G.

(q) After accomplishing proper operation of the BAND CHANGE gear train, replace the retaining ring on the 90-tooth stop-pin gear shaft.

(r) Replace large dial cord pulley and gear assembly as follows: Turn shaft A to counterclockwise stop. Make sure that the 52-tooth gear on shaft E and the 48-tooth detent gear on shaft C are still set at their respective scribe marks. Place pulley and gear assembly far enough on shaft B to engage the rear section of the split gear with the 15-tooth gear on shaft A. Be sure that groove-pin holes on shaft and hub are lined up and that the pulley slot is within 45° of the position shown in figure 7-8. Rotate front section of split gear so that springs stretch to 3/4 inches. Engage front section with 15-tooth gear on shaft A. Replace groove pin and tighten set screw.

(s) Check operation of loading cord by turning shaft A clockwise. Be sure that the loading spring travels from the drum on shaft E to the same relative position at the drum on shaft B when shaft A hits the clockwise stop. The loading spring should not touch either drum at either end of its travel.

(t) Replace small dial cord pulley. Line up with scribe mark and tighten set screw.

(u) Rotate shaft A to its counterclockwise stop, and shaft G to its clockwise stop; then replace the gear box in the receiver. Reconnect couplers; then replace dial cords, front panel and right-hand end bracket. Replace flat washer, tension washer and collar on KILOCYCLE shaft. Push collar against tension washer until tension washer is almost flat; then tighten collar set screws. Replace knobs.

b. RF TUNER ASSEMBLY MAINTENANCE.

(1) GENERAL. - The r-f tuner assembly will require very little maintenance. However, should it be taken apart for any reason, the following information will indicate the correct positions of the cams.

(2) POSITIONS OF CAMS. - The front plate of the slug rack assembly contains three alignment holes as indicated in figure 7-9. If the cams are correctly synchronized, the tips of the front cams will be directly opposite these holes. Use a dental mirror to accurately inspect the position of the cam tips in relation to the alignment holes. If a dental mirror is not available, check positions and operation of the cams in the following manner.

(a) Turn BAND CHANGE knob to band 30. Turn KILOCYCLE knob clockwise to stop.

(b) Viewing the right-hand slug-moving cam from the front, the slug table cam rider should be approximately 1/16-inches to the right of the cam tip. The cam rider should descend this same right-hand edge when step (c) is performed.

(c) Turn BAND CHANGE knob to band 16. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (b), and not bottomed in the low spot of the cam.

(d) Turn BAND CHANGE knob to band 15. Turn KILOCYCLE knob clockwise to stop.

(e) Viewing the center cam from the front, the cam rider should be approximately 1/32-inches to the left of the cam tip. The cam rider should descend this same left-hand edge when step (f) is performed.

(f) Turn BAND CHANGE knob to band 8. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (e) and not bottomed in the low spot of the cam.

(g) Turn BAND CHANGE knob to band 7. Turn KILOCYCLE knob clockwise to stop.

(h) Viewing the left-hand cam from the front, the cam rider should be approximately 1/32-inches to the right of the cam tip. The cam rider should descend this same right-hand edge when step (i) is performed.

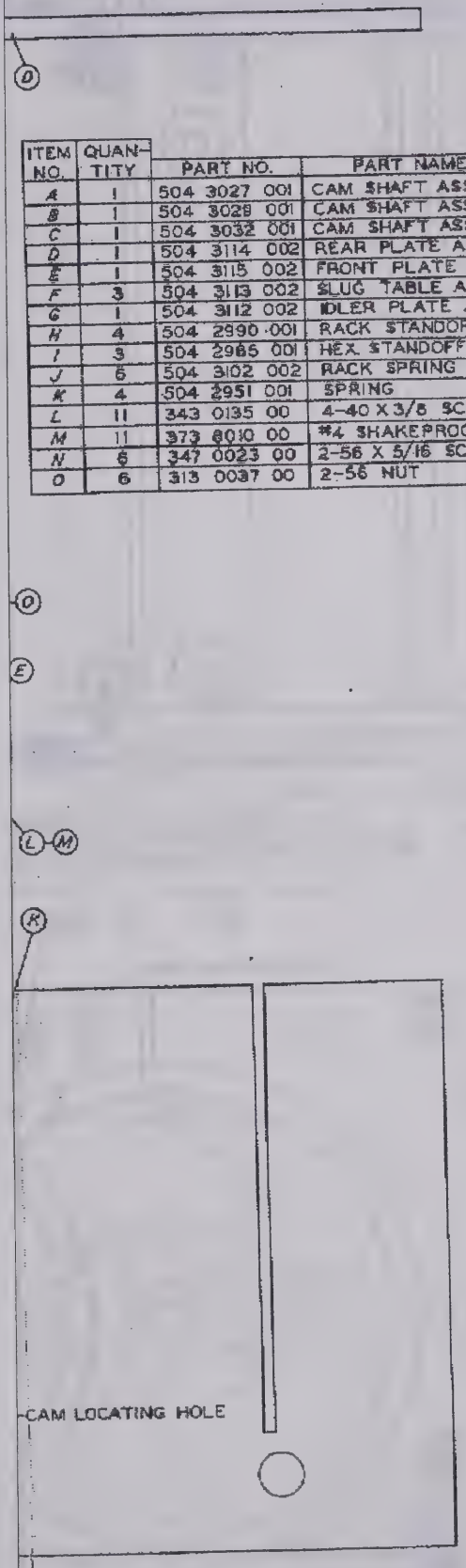
(i) Turn BAND CHANGE knob to band 4. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (h) and not bottomed in the low spot of the cam.

(j) Before putting the receiver into operation again, investigate the electrical alignment of the stages affected by any repair operations, and check the synchronization of the slug rack with the BAND CHANGE mechanism.

7. DISCARDING VACUUM TUBES.

In the course of trouble shooting in the equipment, it may be necessary to replace a defective or inoperative vacuum tube. Tubes should be given a thorough check before being discarded. Before discarding any electron tube, the technician should determine without question that replacement will remedy the trouble. Check the tube in a standard tube tester or

ITEM NO.	QUANTITY	PART NO.	PART NAME
A	1	504 3027 001	CAM SHAFT ASSY
B	1	504 3028 001	CAM SHAFT ASSY
C	1	504 3032 001	CAM SHAFT ASSY
D	1	504 3114 002	REAR PLATE ASSY
E	1	504 3115 002	FRONT PLATE ASSY
F	3	504 3113 002	SLUG TABLE ASSY
G	1	504 3112 002	IDLER PLATE ASSY
H	4	504 2990 001	RACK STANDOFF
I	3	504 2985 001	HEX. STANDOFF
J	6	504 3102 002	RACK SPRING
K	4	504 2951 001	SPRING
L	11	343 0135 00	4-40 X 3/8 SCREW
M	11	373 6010 00	#4 SHAKEPROOF
N	6	347 0023 00	2-56 X 5/16 SCREW
O	6	313 0037 00	2-56 NUT



-9. R-F Slug Rack

(r) Replace large dial cord pulley and gear assembly as follows: Turn shaft A to counterclockwise stop. Make sure that the 52-tooth gear on shaft E and the 48-tooth detent gear on shaft C are still set at their respective scribe marks. Place pulley and gear assembly far enough on shaft B to engage the rear section of the split gear with the 15-tooth gear on shaft A. Be sure that groove-pin holes on shaft and hub are lined up and that the pulley slot is within 45° of the position shown in figure 7-8. Rotate front section of split gear so that springs stretch to 3/4 inches. Engage front section with 15-tooth gear on shaft A. Replace groove pin and tighten set screw.

(s) Check operation of loading cord by turning shaft A clockwise. Be sure that the loading spring travels from the drum on shaft E to the same relative position at the drum on shaft B when shaft A hits the clockwise stop. The loading spring should not touch either drum at either end of its travel.

(t) Replace small dial cord pulley. Line up with scribe mark and tighten set screw.

(u) Rotate shaft A to its counterclockwise stop, and shaft G to its clockwise stop; then replace the gear box in the receiver. Reconnect couplers; then replace dial cords, front panel and right-hand end bracket. Replace flat washer, tension washer and collar on KILOCYCLE shaft. Push collar against tension washer until tension washer is almost flat; then tighten collar set screws. Replace knobs.

b. RF TUNER ASSEMBLY MAINTENANCE.

(1) GENERAL. - The r-f tuner assembly will require very little maintenance. However, should it be taken apart for any reason, the following information will indicate the correct positions of the cams.

(2) POSITIONS OF CAMS. - The front plate of the slug rack assembly contains three alignment holes as indicated in figure 7-9. If the cams are correctly synchronized, the tips of the front cams will be directly opposite these holes. Use a dental mirror to accurately inspect the position of the cam tips in relation to the alignment holes. If a dental mirror is not available, check positions and operation of the cams in the following manner.

(a) Turn BAND CHANGE knob to band 30. Turn KILOCYCLE knob clockwise to stop.

(b) Viewing the right-hand slug-moving cam from the front, the slug table cam rider should be approximately 1/16-inches to the right of the cam tip. The cam rider should descend this same right-hand edge when step (c) is performed.

(c) Turn BAND CHANGE knob to band 16. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (b), and not bottomed in the low spot of the cam.

(d) Turn BAND CHANGE knob to band 15. Turn KILOCYCLE knob clockwise to stop.

(e) Viewing the center cam from the front, the cam rider should be approximately 1/32-inches to the left of the cam tip. The cam rider should descend this same left-hand edge when step (f) is performed.

(f) Turn BAND CHANGE knob to band 8. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (e) and not bottomed in the low spot of the cam.

(g) Turn BAND CHANGE knob to band 7. Turn KILOCYCLE knob clockwise to stop.

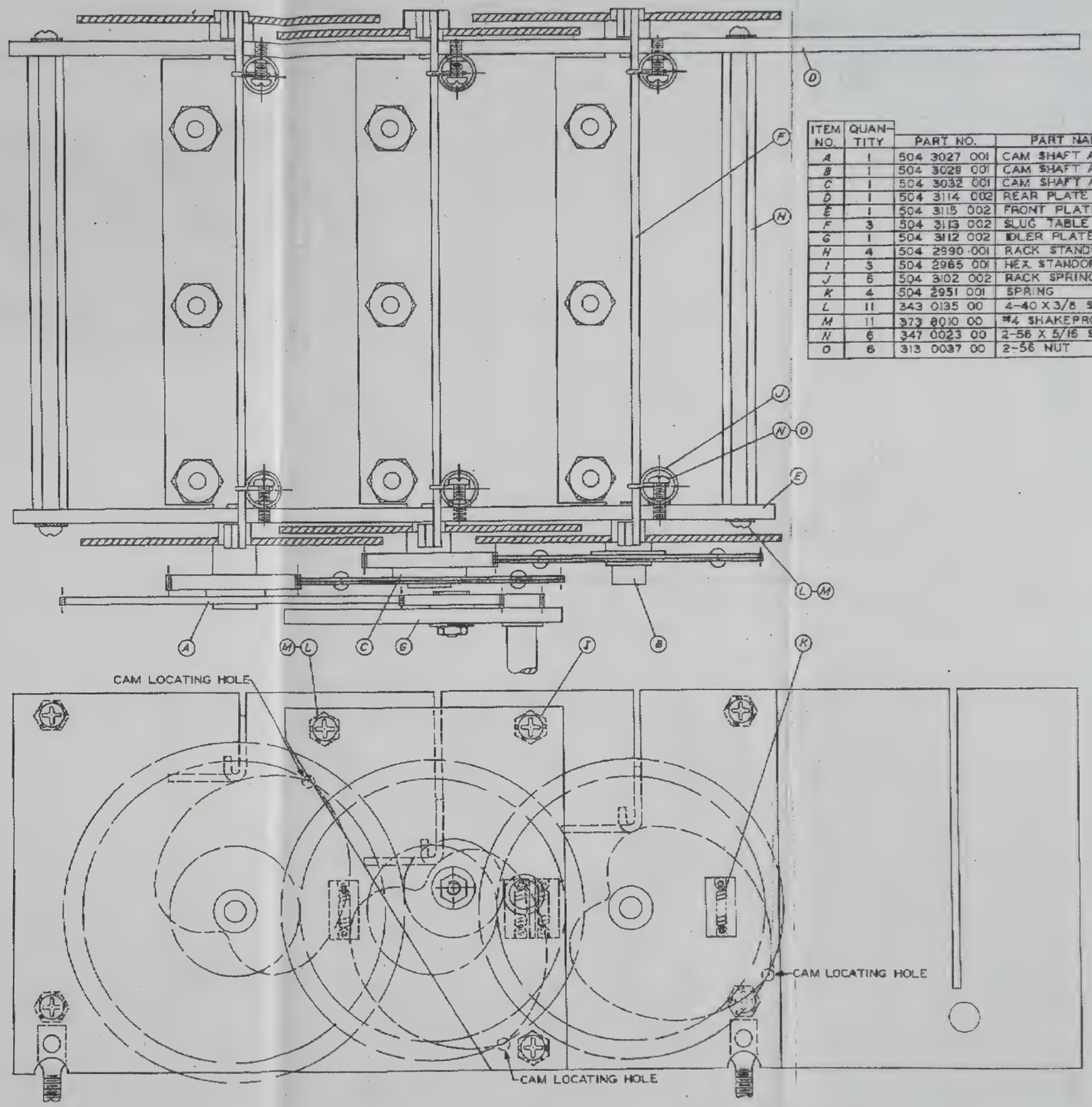
(h) Viewing the left-hand cam from the front, the cam rider should be approximately 1/32-inches to the right of the cam tip. The cam rider should descend this same right-hand edge when step (i) is performed.

(i) Turn BAND CHANGE knob to band 4. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (h) and not bottomed in the low spot of the cam.

(j) Before putting the receiver into operation again, investigate the electrical alignment of the stages affected by any repair operations, and check the synchronization of the slug rack with the BAND CHANGE mechanism.

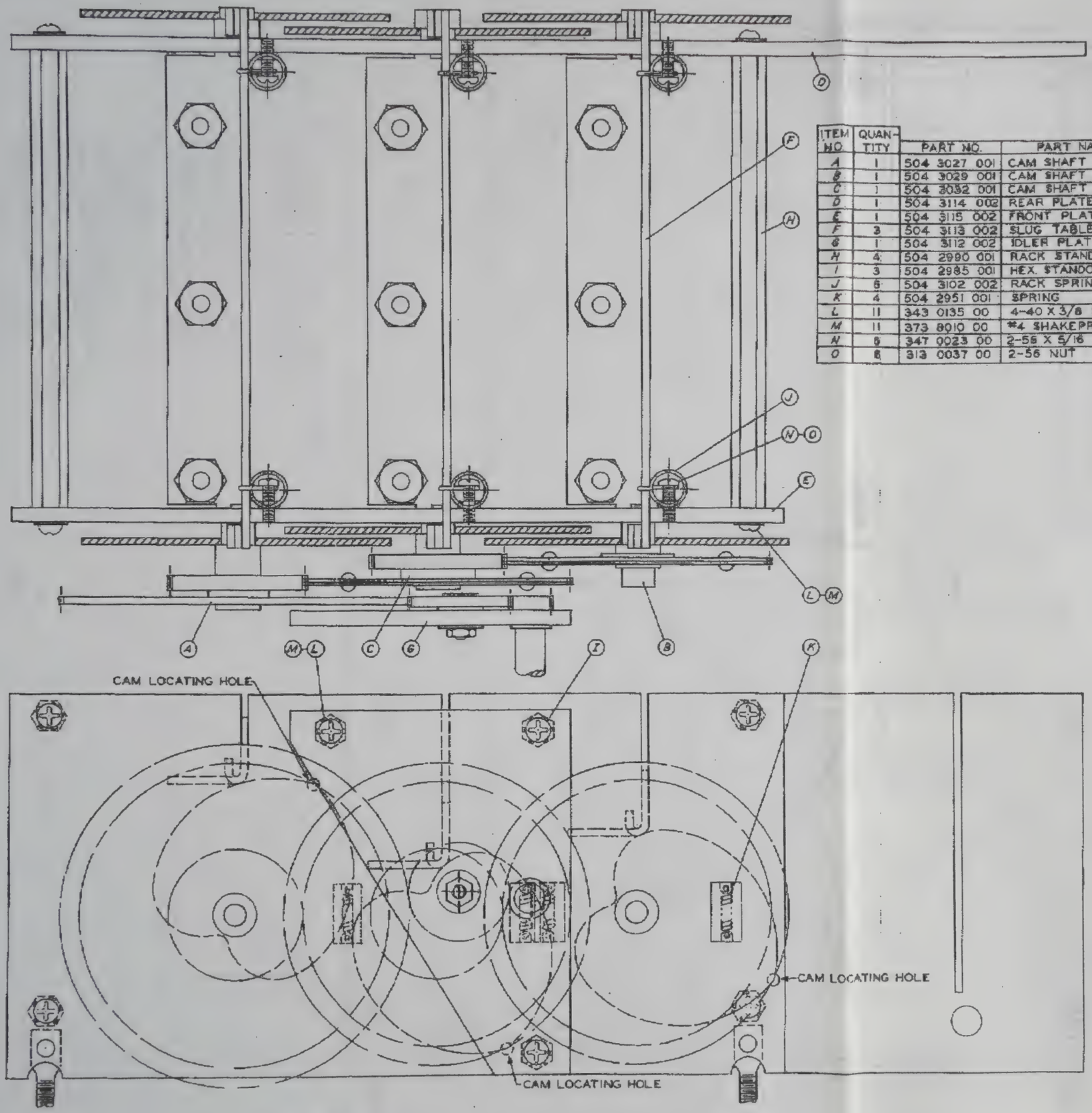
7. DISCARDING VACUUM TUBES.

In the course of trouble shooting in the equipment, it may be necessary to replace a defective or inoperative vacuum tube. Tubes should be given a thorough check before being discarded. Before discarding any electron tube, the technician should determine without question that replacement will remedy the trouble. Check the tube in a standard tube tester or



ITEM NO.	QUANTITY	PART NO.	PART NAME
A	1	504 3027 001	CAM SHAFT ASSY
B	1	504 3028 001	CAM SHAFT ASSY
C	1	504 3032 001	CAM SHAFT ASSY
D	1	504 3114 002	REAR PLATE ASSY
E	1	504 3115 002	FRONT PLATE ASSY
F	3	504 3113 002	SLUG TABLE ASSY
G	1	504 3112 002	IDLER PLATE ASSY
H	4	504 2990 001	RACK STANDOFF
I	3	504 2985 001	HEX STANDOFF
J	5	504 3102 002	RACK SPRING
K	4	504 2951 001	SPRING
L	11	343 0135 00	4-40 X 3/8 SCREW
M	11	373 0010 00	#4 SHAKEPROOF
N	6	347 0023 00	2-56 X 5/16 SCREW
O	6	313 0037 00	2-56 NUT

Figure 7-9. R-F Slug Rack



ITEM NO	QUANTITY	PART NO.	PART NAME
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F	3	504 3113 002	SLUG TABLE ASSY
G	1	504 3112 002	IDLER PLATE ASSY
H	4	504 2990 001	RACK STANDOFF
I	3	504 2985 001	HEX. STANDOFF
J	6	504 3102 002	RACK SPRING
K	4	504 2951 001	SPRING
L	11	343 0135 00	4-40 X 3/8 SCREW
M	11	373 8010 00	#4 SHAKEPROOF
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O	6	313 0037 00	2-56 NUT

Figure 7-9. R-f Slug Rack

QUAN-TITY	PART NO.	PART NAME
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1	504 3032 001	CAM SHAFT ASSY
1	504 3114 002	REAR PLATE ASSY
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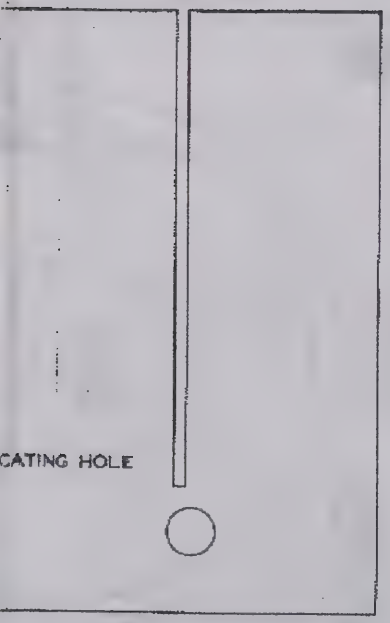
3	504 3113 002	SLUG TABLE ASSY
1	504 3112 002	IDLER PLATE ASSY
4	504 2990 001	RACK STANDOFF
3	504 2985 001	HEX. STANDOFF
6	504 3102 002	RACK SPRING
4	504 2951 001	SPRING
11	343 0135 00	4-40 X 3/8 SCREW
11	373 8010 00	#4 SHAKEPROOF
8	347 0023 00	2-56 X 5/16 SCREW
8	313 0037 00	2-56 NUT



in actual operation and discard only if it shows one of the following faults:

a. Low emission: sufficient to prevent minimum efficient operation.

b. No filament continuity.

c. Microphonics: noise interference with operation.

d. Shorted element.

e. Intermittent shorts: tube cannot continue in use until reception is completed.

When it is definitely ascertained that the tube is valueless in operation and requires replacement, observe the following rule: "ALL TUBES OF A GIVEN TYPE SUPPLIED WITH THE EQUIPMENT SHALL BE CONSUMED PRIOR TO EMPLOYMENT OF TUBES FROM GENERAL STOCK."

TABLE 7-2 TUBE CHARACTERISTICS

TUBE TYPE	Filament Voltage (volts)	Filament Current (ma.)	Plate Voltage (d-c volts)	Grid Bias (d-c volts)	Screen Voltage (d-c volts)	Plate Current (ma.)	Screen Current (ma.)	A-C Plate Resistance (ohms)	Voltage Amplification Factor (mu)	Trans-conductance (micromhos)
			TYPICAL OPERATING CHARACTERISTICS							
6AK5	6.3	0.175	180	----	120	7.7	2.4	0.69m	3500	5100
6BA6	6.3	0.3	250	-20	100	11.0	4.2	1.5 m	---	4400
6BE6	6.3	0.3	250	- 1.5	100	3.0	7.11	1.0 m	---	475
12AX7	6.3	0.3	250	- 2.0	---	1.2*	---	62,500*	100*	1600*
12AU7	6.3	0.3	250	- 8.5	---	10.5*	---	7,700*	17*	2200*
6AQ5	6.3	0.45	250	-12.5	250	45.0	4.5	52,000	---	4100
5V4	5.0	2.0	500x	----	---	525x	---	---	---	---
OA2	---	---	150#	----	---	30#	---	---	---	---

* Each triode

x With choke-input filter--a-c plate voltage per plate (RMS). Current per plate. peak inverse plate voltage--1400

\# D-c operating voltage and current
185-volt minimum d-c anode supply
155 volts starting

8. CRYSTAL DATA.

a. HIGH FREQUENCY OSCILLATOR. - The high frequency oscillator in this receiver is crystal controlled, supplying injection frequencies to the first mixer, V102, on bands 4 to 30, and injection frequencies to both the first mixer and the band 1 mixer, V103, when operating on band 1. No injection frequency is employed on bands 2 and 3 since these bands cover the identical frequency range of the two variable i-f channels. The injection principal is such that, by utilizing fundamental crystal frequencies along with harmonics and associated harmonic selector circuits, injection frequencies for the 28 bands employing hfo injection are obtained from only 10 crystals.

The ten crystals are mounted on one board (XY-101, XY-110). Crystal data is as follows:

Temperature range	-55°C (-67°F) to 90°C (194°F)
Tolerance	±0.005% of nominal frequency when measured over the temperature range.
Load capacitance	32 ± 0.5 uuf
Crystal holders	Two pins on bottom spaced 0.486" c to c.
	Solid pins 0.050" diam, x 0.234" lg.
	2 pins only.
	Oval metal body 0.750" lg x 0.345" wd x 0.788" h.
	No air gap adj.

The following data outlines the injection frequency scheme.

CRYSTAL	MARKED NOMINAL FREQUENCY-KC	USED ON BANDS	HARMONIC EMPLOYED	1ST MIXER INJECTION FREQUENCY-MC
Y-101	10,666.67	29-30	3rd	32
Y-102	13,000.00	23-24	2nd	26
Y-103	11,000.00	19-20	2nd	22
Y-104	9,000.00	15-16	2nd	18
Y-105	14,000.00	11-12	Fund.	14
		25-26	2nd	28
Y-106	12,000.00	9-10	Fund.	12
		21-22	2nd	24
Y-107	10,000.00	7-8	Fund.	10
		17-18	2nd.	20
		27-28	3rd	30
Y-108	8,000.00	5-6	Fund.	8
		13-14	2nd	16
Y-109	6,000.00	4 only	Fund.	6
Y-110	4,000.00	1 only	2nd.	8*
			3rd	12

* 8 mc injection to Band 1 Mixer on Band 1 only.

b. 100-KC CALIBRATION OSCILLATOR. - The frequency of the calibration oscillator is controlled by a 100-kc crystal, using the fundamental mode. Data on this crystal, Y111, is as follows:

Temperature range	0°C (32°F) to 70°C (158°F).
Nominal frequency	100 kc
Tolerance	Within ±0.01% at 25°C (77°F) and shall not deviate from the frequency at this temperature by more than ± 0.007% over the temperature range.
Crystal holder	Two pins on bottom spaced 0.486" c to c.
	Solid pins 0.093" diam x 15/32" lg.
	2 pins only.
	Cylindrical body 1-1/8" diam x 2-1/4" lg.
	No air gap adj.
	Marked 100 kc.

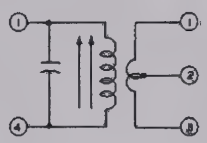
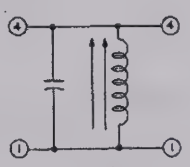
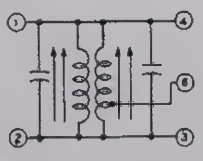
c. 500-KC I-F FILTER. - A 500-kc filter unit is placed between the output of the Second Mixer and the input to the First I-F Amplifier. The filter employs a 500-kc crystal, the data on which is as follows:

Nominal frequency	500 kc
Tolerance	500 kc ± 500 cycles at series resonance at 25°C (77°F)
Crystal holder	Two pins on bottom spaced 0.486" c to c.
	Solid pins 0.030" diam. x 1" lg.
	2 pins only.
	Oval body 3/4" lg x 3/8" wd x 19/32" h less term.
	No air gap adj.
	Marked 500-kc.

TABLE 7-3 WINDING DATA

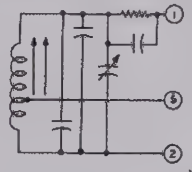
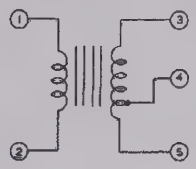
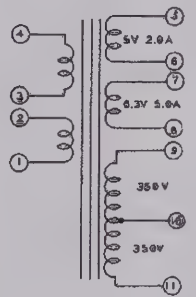
DESIGNATION	COLLINS PART NUMBER	DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RESISTANCE IN OHMS	Z RATIO	TEST VOLTS
L-101 L-110	504-3056-001		Single layer Single cam wound	35E	75	less than 1 ohm		
L-102	505-2147-002		Single layer Single cam wound	28E	48	less than 1 ohm		
L-103	505-2148-002		Single layer Single cam wound	28E	43	less than 1 ohm		
L-104 L-107 L-111	504-3060-001		Single layer Single cam wound	28E	27	less than 1 ohm		
L-105 L-108 L-112	504-3061-001		Single layer Single cam wound	28E	20	less than 1 ohm		
L-106 L-109 L-113	504-3062-001		Single layer Single cam wound	28E	15	less than 1 ohm		
L-114 L-116	504-3064-001		Single layer Single cam wound	28E	48	less than 1 ohm		
L-115	504-3057-001		Single layer Single cam wound	28E	16	less than 1 ohm		
L-117 L-119	504-3066-001		Universal Single wound	9-41 Litz	46	less than 1 ohm		
L-118	504-5347-001		Single layer Single cam wound	28E	48	less than 1 ohm		
L-120	503-4535-001		Universal Triple wound	36 nylon E	112 each winding	less than 1 ohm		

TABLE 7-3. WINDING DATA, CONT.

DESIGNATION	COLLINS PART NUMBER	DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RESISTANCE IN OHMS	Z RATIO	TEST VOLTS
L-121	504-3074-001		Single layer Single wound Closely spaced Tapped at 13 turns	30EE	46	less than 1 ohm		
L-122	678-0432-00		Multi-layer Single wound	31PE	1923	100		2500 rms
L-123	678-0431-00		Multi-layer Single wound	35PE	2745	300		2500 rms
L-124	504-6646-002		Single layer Single wound	28E	46			
L-125	240-0073-00		Pie Universal Triple wound	36 nylon E8	112 each winding			
T-101	278-0093-00		Universal Pri Sec	10/41 SNNTE*	 213 46 tap at 23	 4.4 1.7		150 DC
T-102	278-0092-00		Universal	10/41 SNNTE	227	4.8		150 DC
T-103 T-104 T-105	278-0090-00		Universal Pri Sec	10/41 SNNTE	102 102	1.3 1.3		150 DC

*Single Nylon, Nylon type Enamel

TABLE 7-3. WINDING DATA, CONT.

DESIGNATION	COLLINS PART NUMBER	DIAGRAM	WINDING	WIRE SIZE	TURNS	DC RESISTANCE IN OHMS	Z RATIO	TEST VOLTS
T-106	270-0091-00		Single Tapped at 31 turns	10/41 SNNTE*	81 tap at 31	1.3		150 DC
T-107	677-0430-00		Pri 1-2 Sec 3-4 Sec 4-5	38 34 24	1736 574 52	362±19% 51±13% 0.36±6%		1500 rms 1500 rms 1500 rms
T-108	672-0429-00	 Series Pri 230V line 1-4 Tie 2-3 Parallel Pri 115V line 1-4 Tie 1-3 Tie 2-4	Pri 1-2 Pri 3-4 Sec 5-6 Sec 7-8 Sec 9-11	25PE 25PE 21PE 16PE 32PE	376 376 18 22.5 2404 ct at 1202	14.6±6% in series 0.19±6% 0.075±6% 197±11%		2500 rms 2500 rms 2500 rms 2500 rms

*Single Nylon, Nylon type Enamel

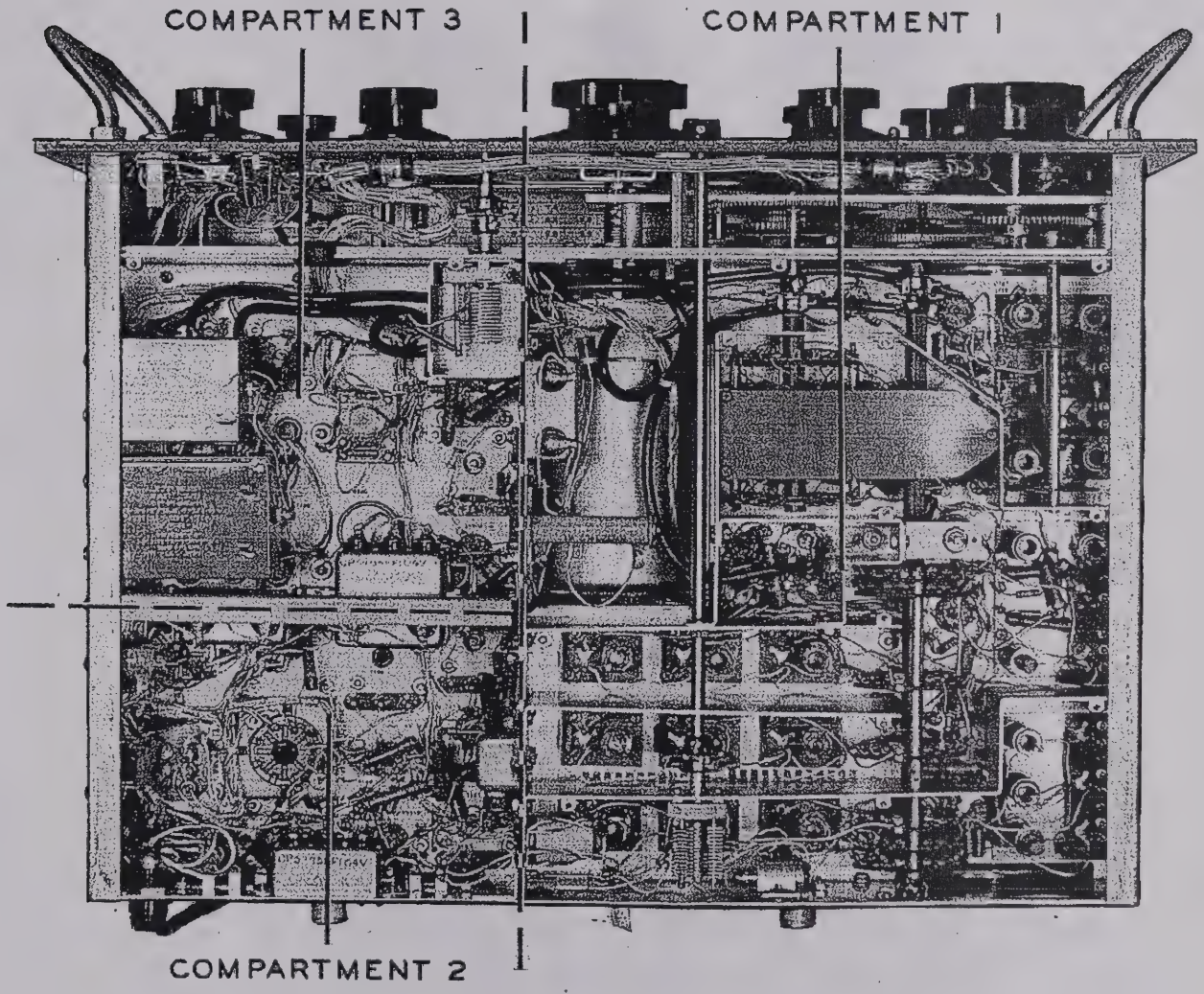


Figure 7-10. Bottom View

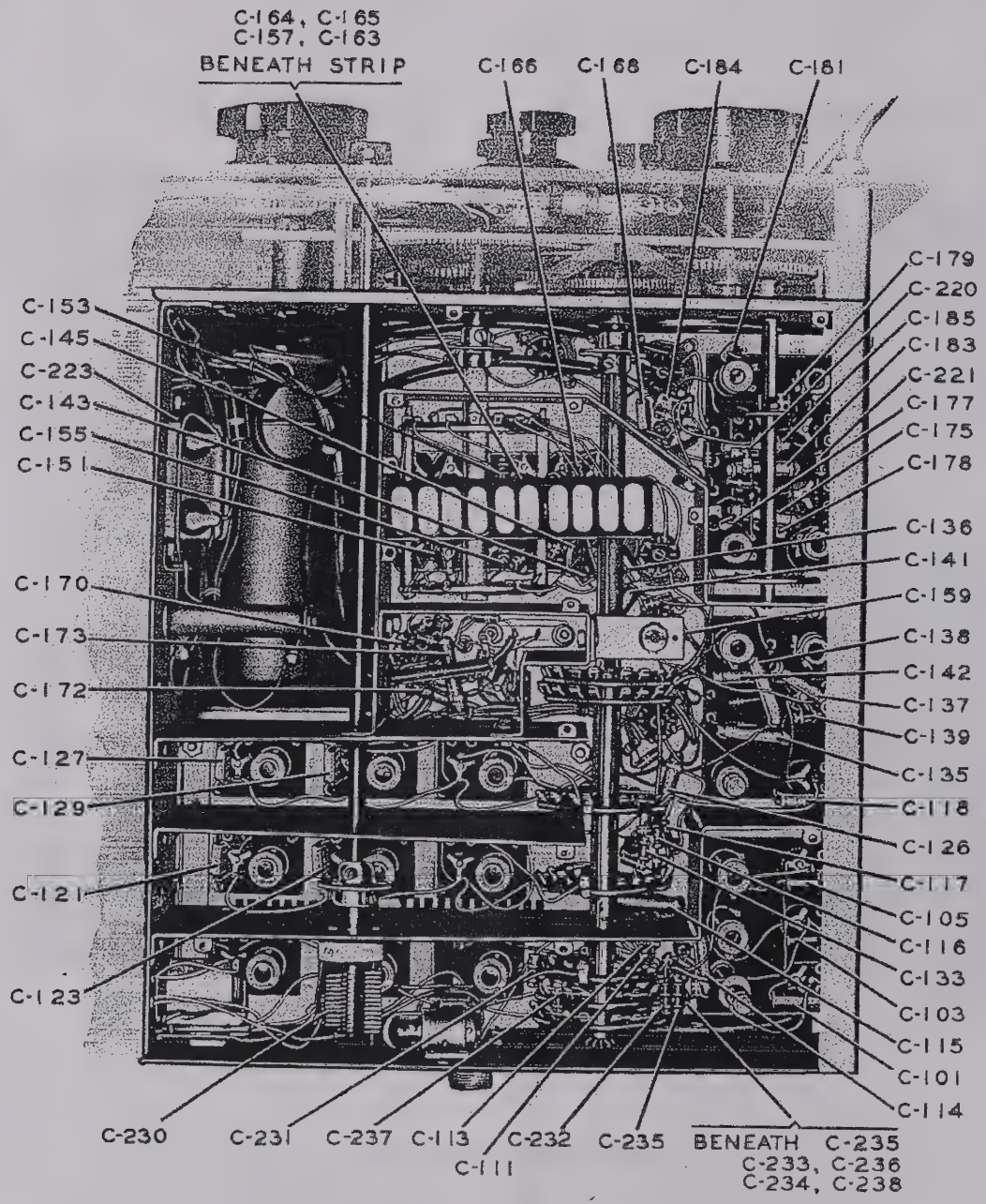


Figure 7-11. Bottom View, Compartment 1, Capacitor

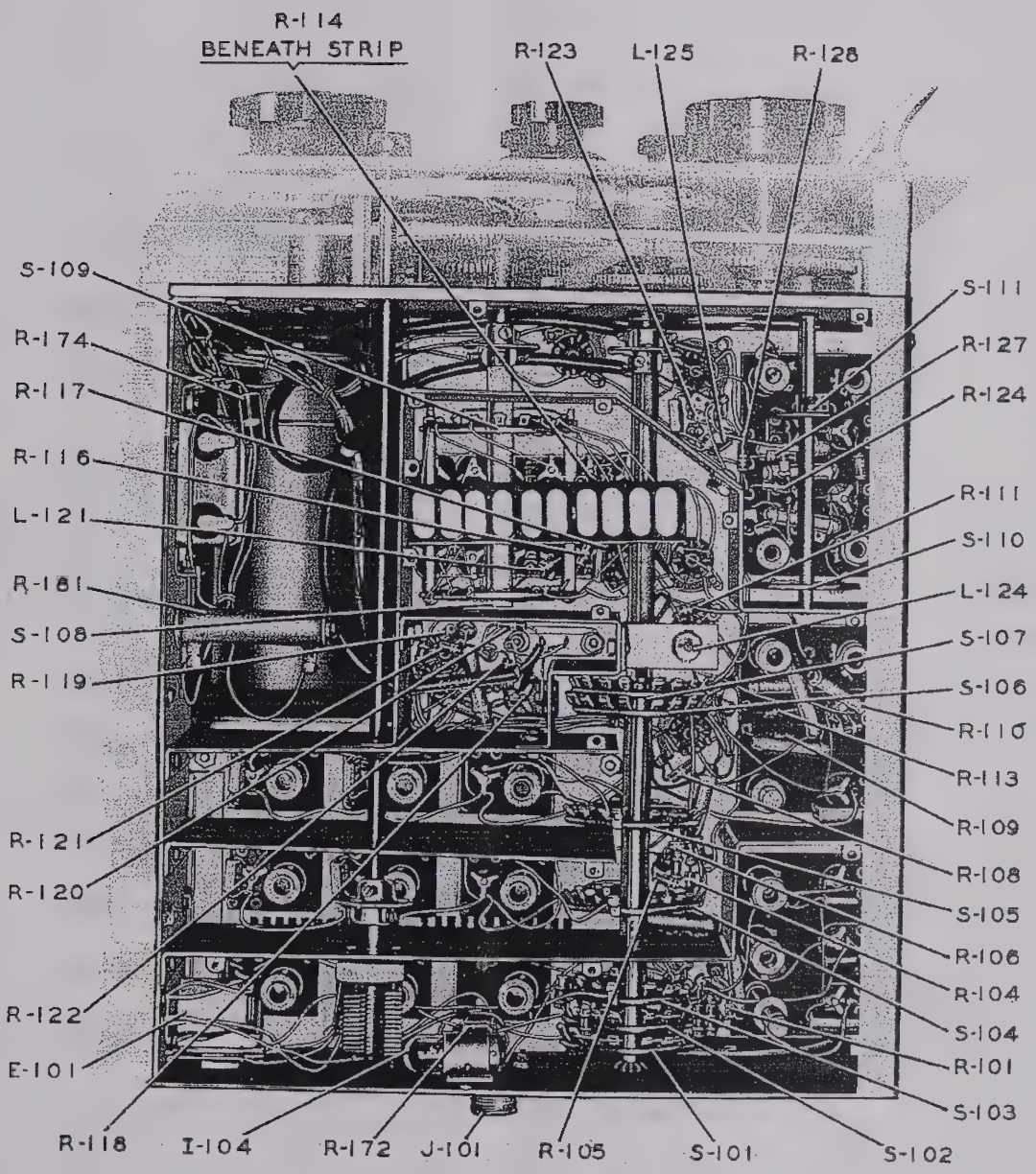


Figure 7-12. Bottom View, Compartment 1, General

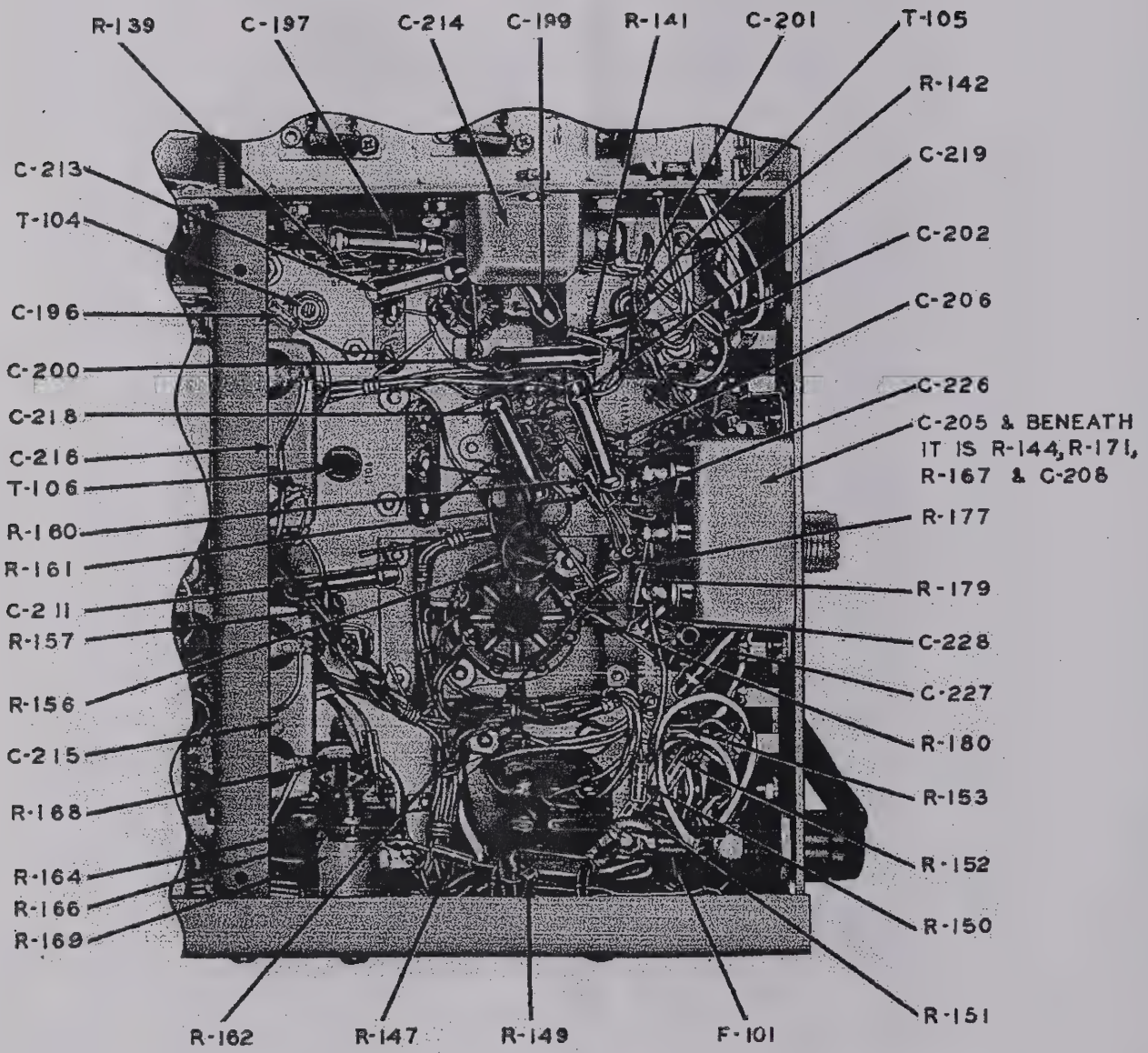


Figure 7-13. Bottom View, Compartment 2

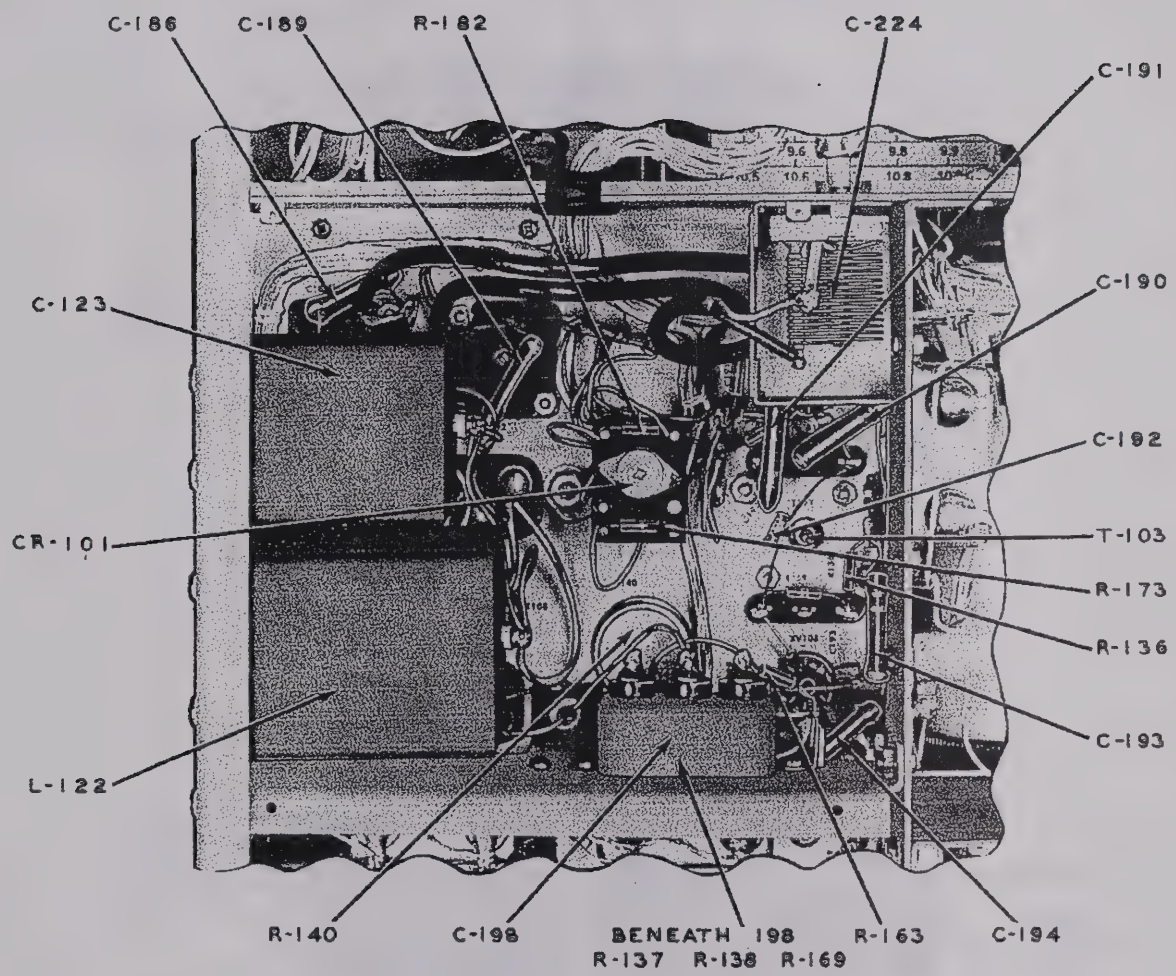


Figure 7-14. Bottom View, Compartment 3,

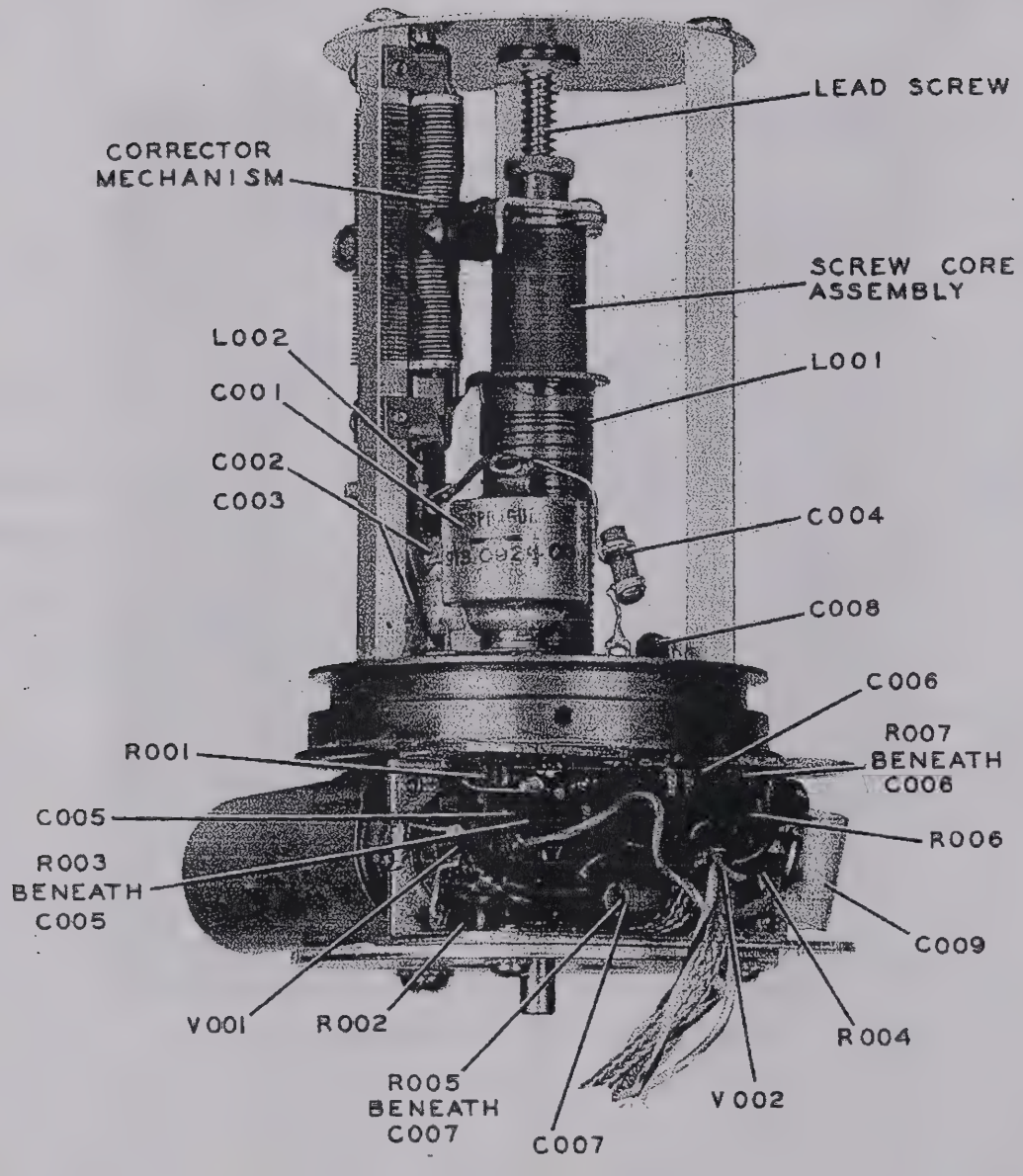
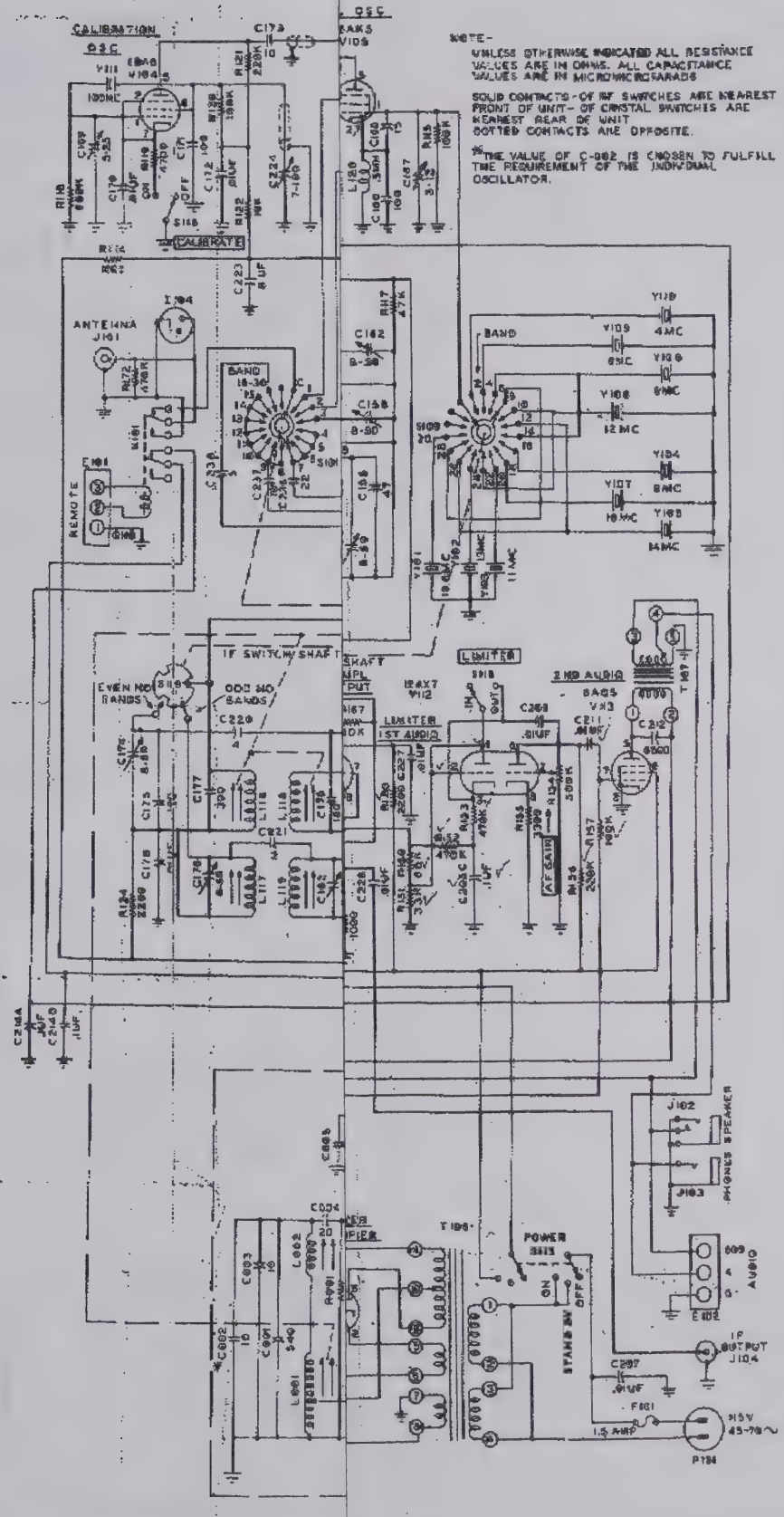


Figure 7-15. Variable Frequency Oscillator, Cover and Shield Removed



ain Schematic Diagram

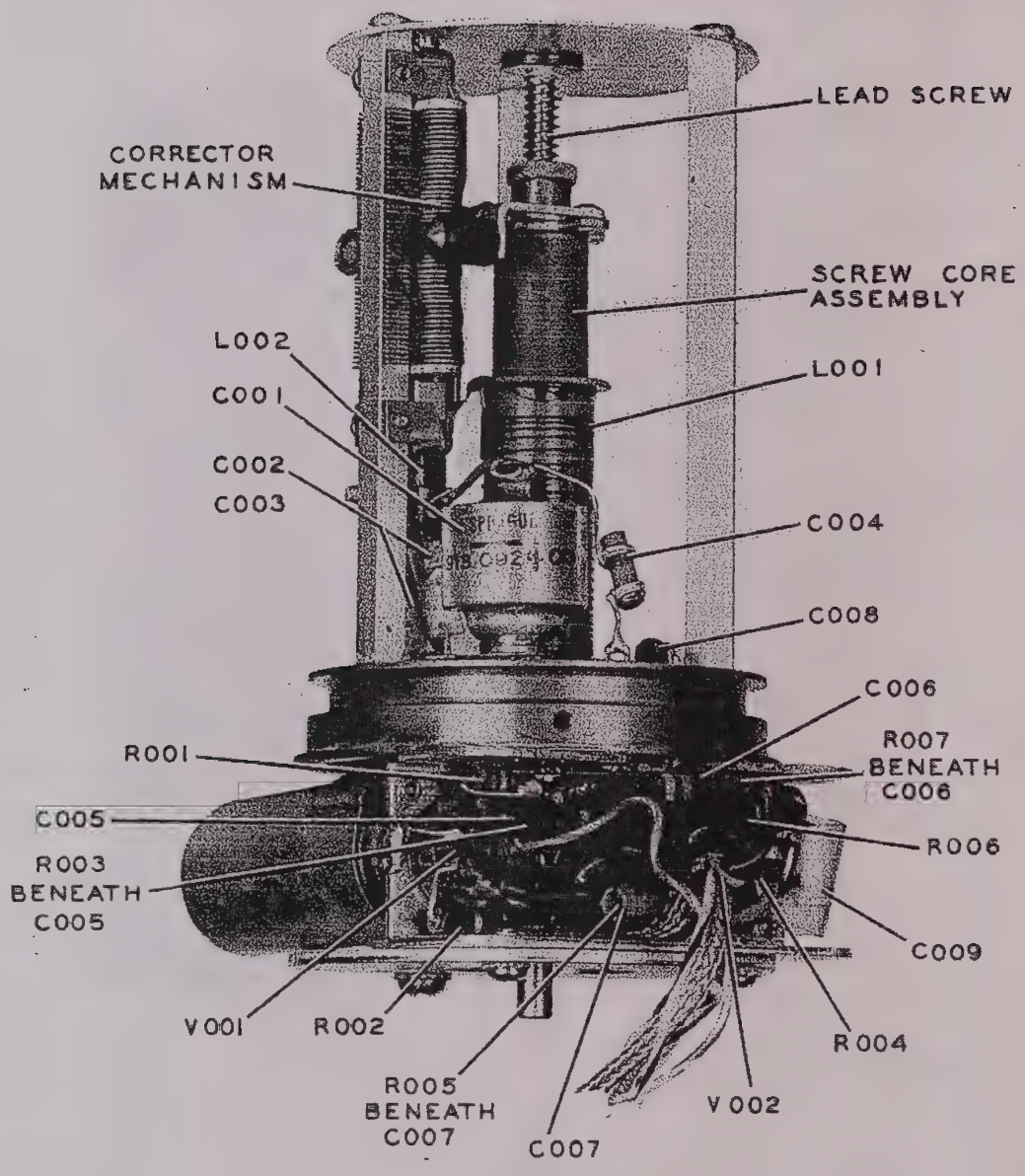


Figure 7-15. Variable Frequency Oscillator, Cover and Shield Removed

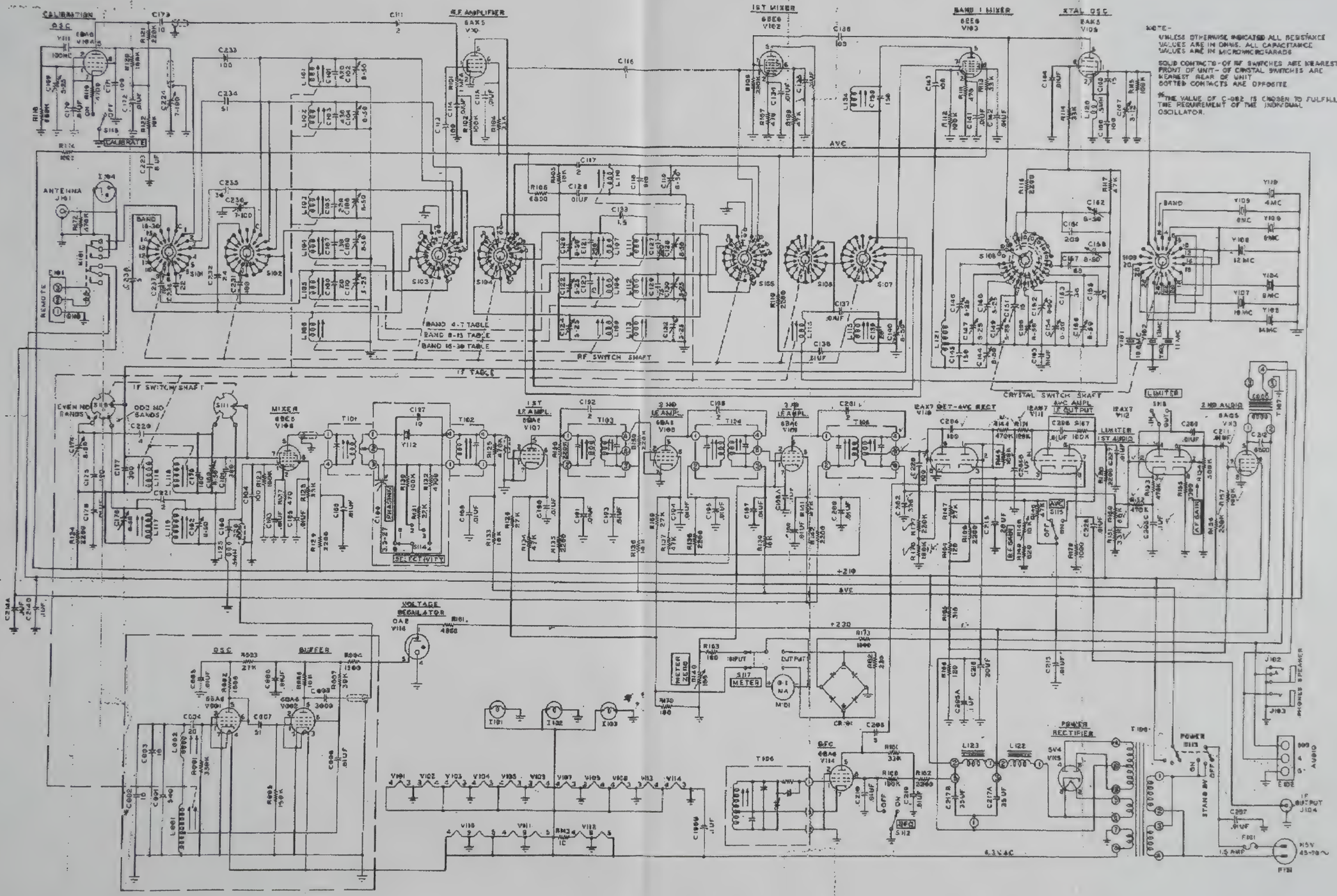
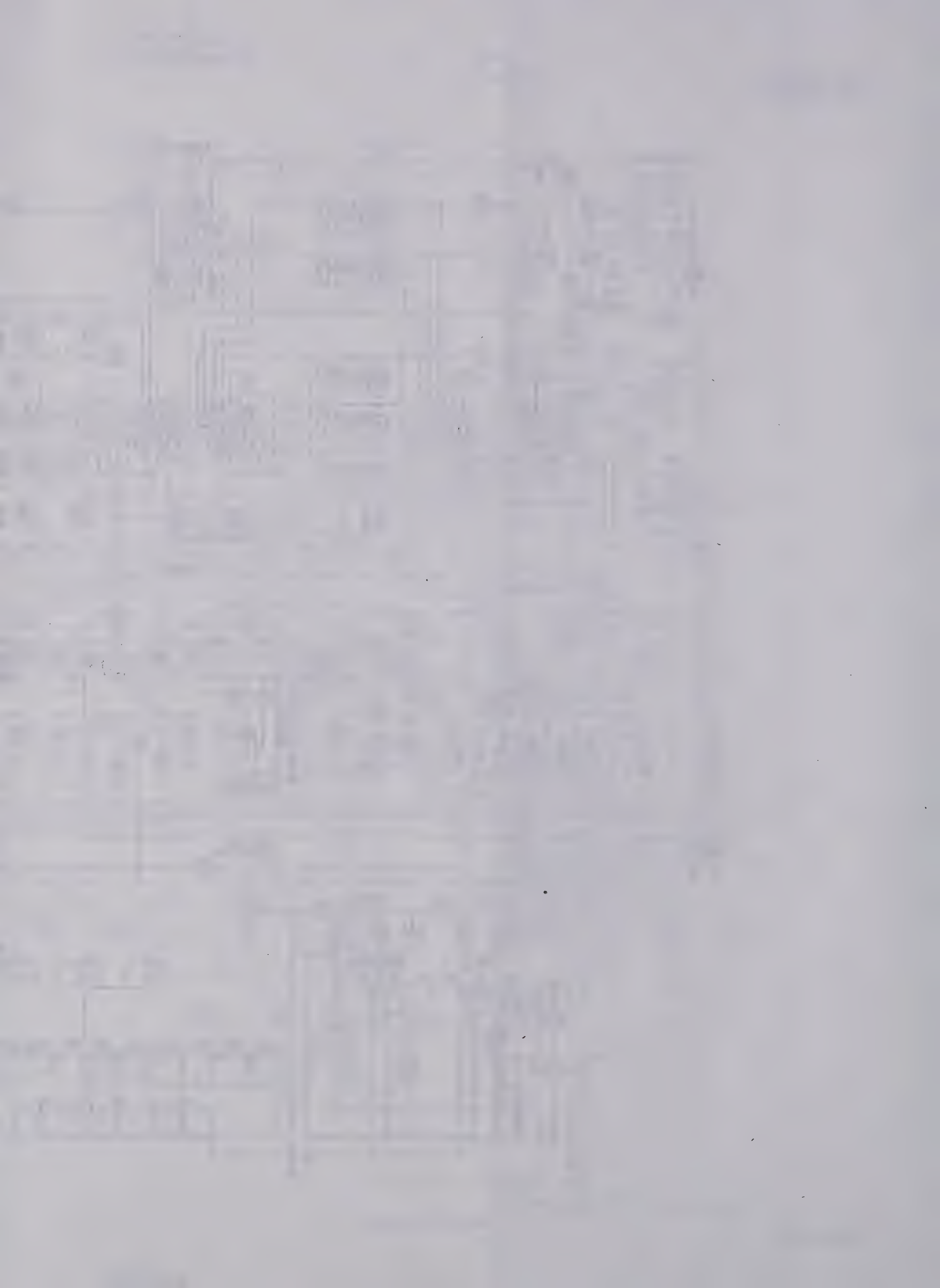


Figure 7-16. Main Schematic Diagram



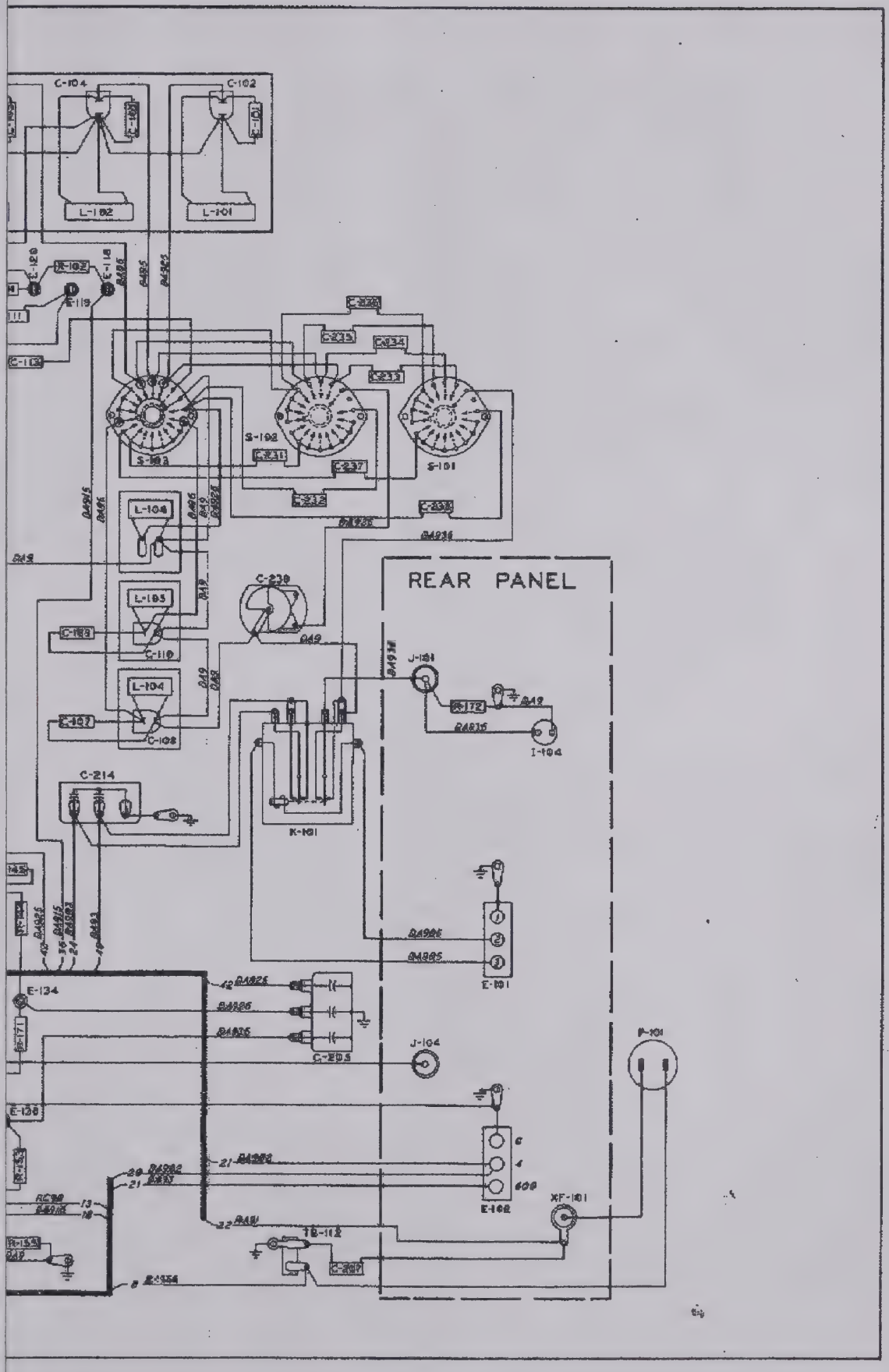
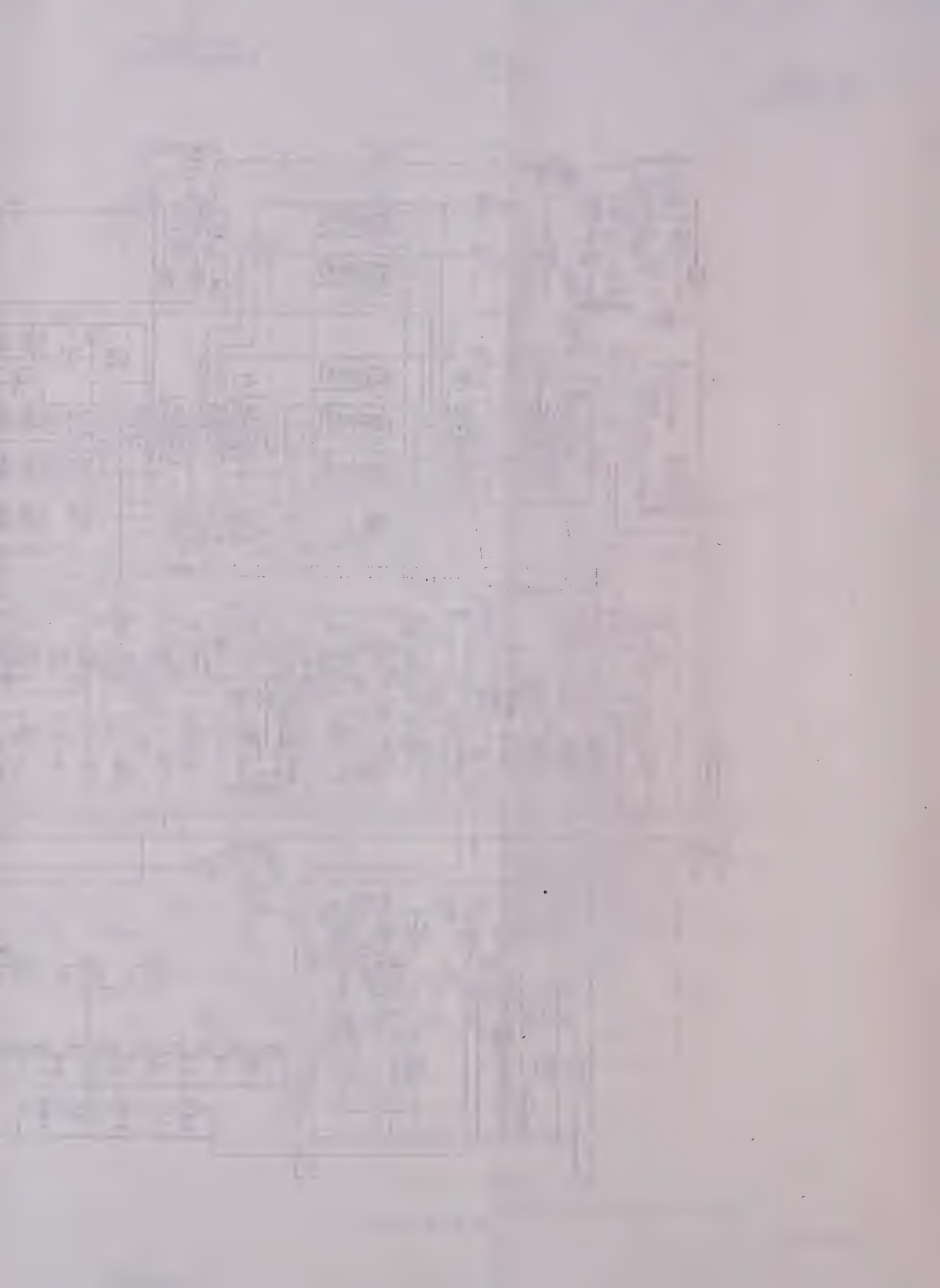


Figure 7-17. Practical Wiring Diagram



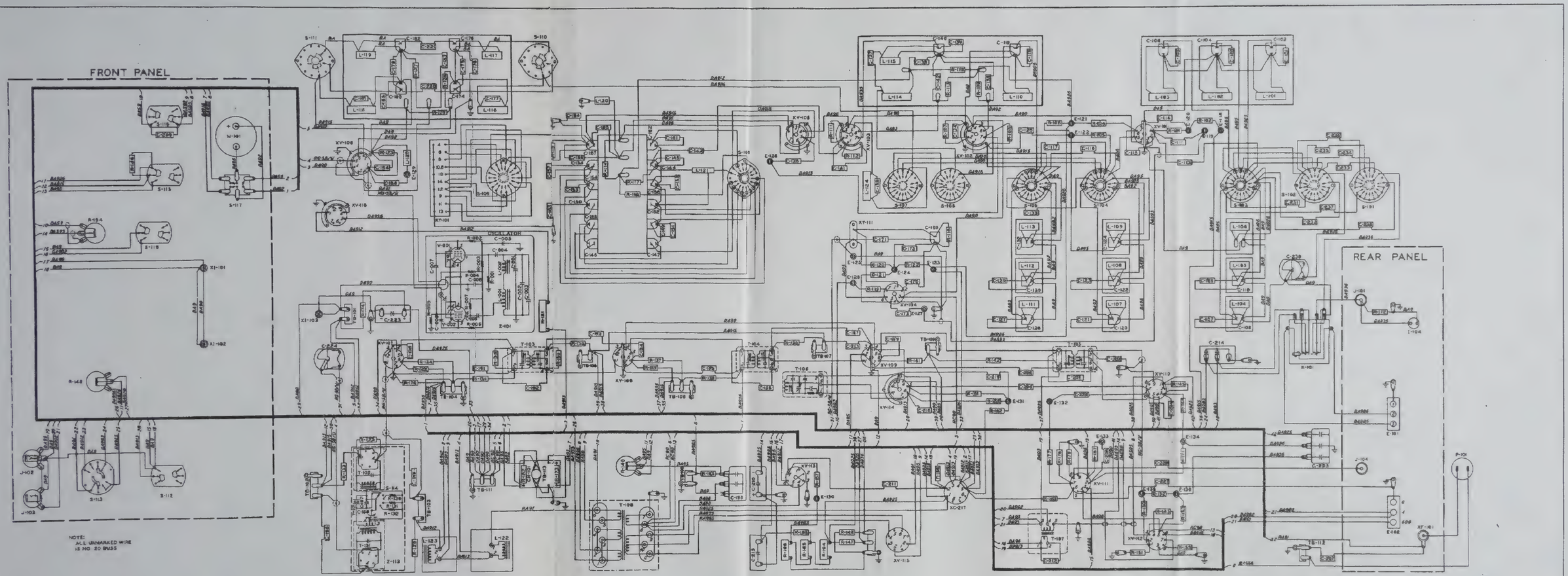


Figure 7-17. Practical Wiring Diagram

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